JUN 13 1932

# Compressed Air Magazine

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## JUNE, 1932

*CIRCULATION THIS ISSUE*
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Ewing Galloway, New York

**Packing Coffee the New Way**
C. H. Vivian

**Switzerland's Rival—the San Juan Region of Colorado**
Allen S. Park

**Construction of Hoover Dam**
Copeland Lake

**Chesapeake and Ohio Making Ready for Bigger Business**
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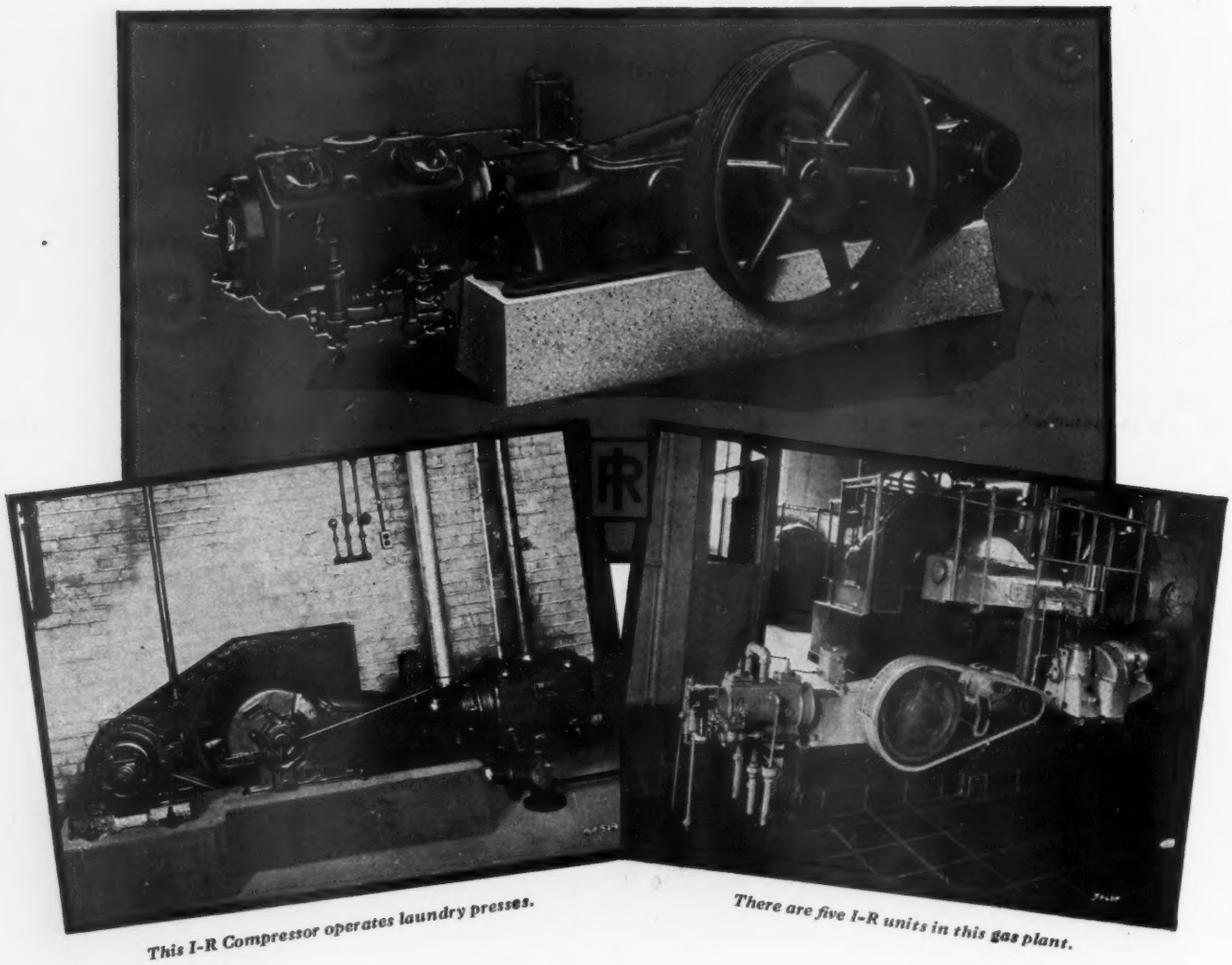
# Ingersoll-Rand Compressors Use Less Power



*This I-R Compressor operates laundry presses.*

*There are five I-R units in this gas plant.*

EFFICIENCY is of the utmost importance in single-stage compressors, because in the first place the power per unit of air delivered is higher than for larger two-stage machines, and in the second place the user of a small compressor will generally have to pay a higher rate per kilowatt hour.

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Ingersoll-Rand single-stage compressors are designed to secure the greatest possible efficiency. Economical unloading devices make pronounced savings in power consumption at fractional loads.

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# As It Seems To Us

### SMALL DIESEL ENGINES

DURING the early development of the diesel engine, the trend was towards increasingly larger units. This movement has been carried to the point where single engines of 20,000 hp. are now available, and one of as much as 80,000 hp. has been projected for installation in a ship.

With the larger diesel having won its place in the sun, there is now apparent a definite turn toward commercialization of smaller sizes. Much has been done along this line in the past five years; but the real work of developing and applying the small diesel to the many uses that await it is still ahead. Many private laboratories are working on the problem in Germany; and both the British and the United States governments have set up extensive facilities for research. Nationalistic interests are, of course, centered around the possibilities of utilizing the diesel for aeronautic propulsion. Meanwhile, the Packard group has sponsored several impressive flights to demonstrate the practicability of its privately developed engine.

In addition to the place that awaits the diesel in aviation, there is a positive demand for it for tractors and for trucks and buses. These demands are more in evidence in foreign countries than in the United States because of the greater spread between the price of gasoline and of fuel oil; but even in this country a great deal of time and thought and money is being devoted to the investigations. In New Jersey, Public Service Coördinated Transport, the largest bus operator in the United States, has imported two British made engines which are in regular daily service under the watchful eyes of engineers and cost accountants. In the report of that company for 1931 is the notation that "experimental work on diesel engines was continued during the year", and that "it is the belief of our engineers that a diesel engine will shortly be developed by manufacturers which will reduce bus operating and maintenance costs."

The depression, with its accompanying low prices for farm products, has spurred the efforts of farm-machinery makers to develop an efficient diesel adapted to their needs. Lower operating cost, effected through high fuel economy, is the goal they are striving for. Engineers of the Caterpillar Tractor Company have shown that surprising savings are possible with diesel power. A gasoline tractor consumes approximately 7 gallons of fuel per hour under normal full-load operation, whereas a diesel tractor under the same conditions should use only 4½ gallons of fuel. As there is a difference of around ten cents a gallon in the prices of the two fuels in the average farming district of this country, a tremendous saving would result with diesels. Even if gasoline and fuel oil were both selling at fifteen cents a gallon, it would cost $1,125 a year less to operate a diesel tractor 3,000 hours a year. Since there are places in the world where gasoline commands sixty cents and even eighty cents a gallon while fuel oil can be obtained for from seven cents to nine cents a gallon, it is easy to see why the development of a suitable diesel engine for tractors would materially lighten the economic burden of the farmer.

### PROGRESS AT HOOVER DAM

ACTIVITIES at Hoover Dam may be perceptibly slowed down through congressional pruning of the appropriation for the ensuing fiscal year; but, even should this happen, it will not deprive Six Companies Incorporated of the prestige that goes with the compiling of a notable record for speed of accomplishment thus far. The world at large had been so thoroughly told about the magnitude of the work in Black Canyon that it expected the job to drag out endlessly. The contractors quickly dispelled such illusions by organizing and digging in with almost incredible dispatch, and, before they had been on the scene a year, operations were proceeding at such a pace that 3,200 men were employed and more than $1,000,000 worth of work a month was being done. If the funds are not curtailed, by the end of 1937—the time set for completion—the enterprise will likely have been functioning for at least a year.

### GOLD—THE KING OF METALS

THE feverish hunt for gold goes on as general business rides the bumps of the depression. World production of gold rose in 1931 to the highest point of any post-war year. Meanwhile, new sources of supply are being sought with gold pan, dredge, diamond drill, and the rest of the category of tools and appliances which have been evolved since Biblical times. A lone prospector with his plodding burro hears a noise overhead and sees an airplane speeding to fields that are beyond his range. The motivating impulse is the same in the two searchers, however.

Canada, Japan, and Germany, all are combing their possible sources of new deposits. Kings and prime ministers share with the unemployed man in the street the yearning for the yellow metal. Common stock of America's premier gold mine has doubled in price since 1929, and in recent weeks it was the only junior security to sell above $100 a share on the New York Stock Exchange. Economists tell us that the world supply of gold is ample for the purposes of business; but the average person has not seen a gold coin in months. The entire British Empire recently went through bureau drawers and delved into nooks to garner its old gold, and sent it to London to collect a premium on it.

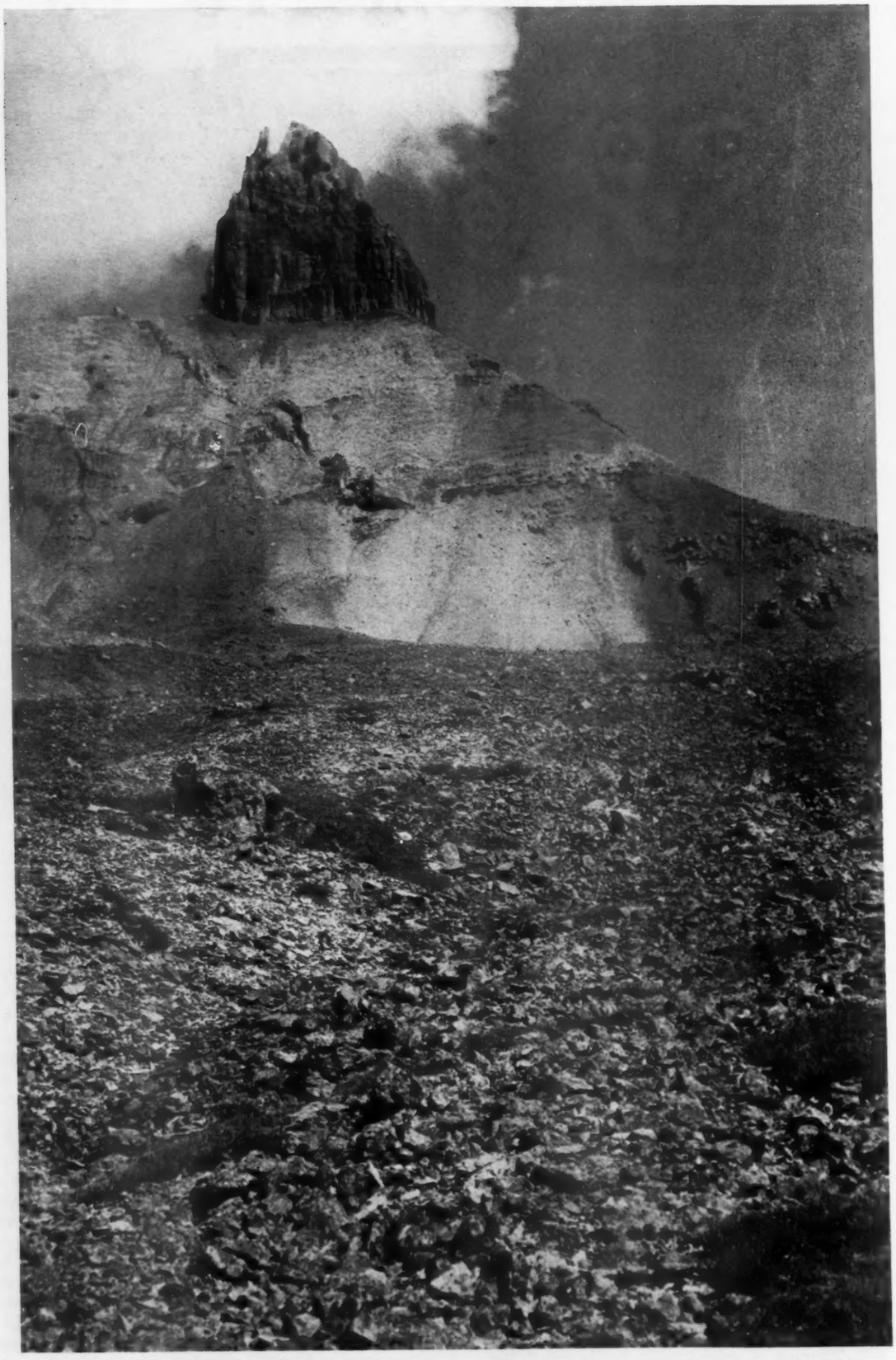
With all eyes focused on gold, the baser metals have continued to suffer. The plight of copper is a sad one, and there is no silver lining in the cloud that hovers over silver. Just how far depreciation has gone in the valuation set upon some of the world's foremost mining ventures is shown by the fact that one could buy the entire capital stock of a leading Canadian company for less than its physical plant-equipment cost. At such a price, the purchaser would obtain its 135,000,000 tons of proved ore for nothing. It is reported that the same condition prevails with respect to one of the large African copper-mining companies.

### NOISES—GOOD AND BAD

NOISE, we are told, is one of the curses of urban life—a thing that wears us out and frays our nerves. Subways, elevated and surface railroads, rumbling trucks, and many other din-producing agencies, are supposed to be making city dwellers jumpy and irascible. But we have it on the authority of numerous poets that music possesses charms that soothe. Now comes the "electric ear" to inform us that the voices of certain singers produce a volume of sound which surpasses that of some of the accepted evils of large centers.

The "electric ear" is a scientific instrument, developed by General Electric Company, which transforms sounds into electrical currents which can be measured against currents arising from other sounds of known intensity. The unit of measurement is the decibel. This inanimate detective attended grand opera in New York a few weeks ago and dug up some startling facts. It discovered that the voice of BENIAMINO GIGLI, the tenor, reached an intensity of 77 decibels during a rendition of *Rigoletto*. A street car, by contrast, produces only 65 decibels, and a subway train registers only 95. In the climax of the *Caro Nome* aria, LILY PONS' coloratura soprano reached 75 decibels. The applause that greeted these two offerings rose to intensities of 77 and 80 decibels, respectively.

These truths lead inevitably to the conclusion that sound alone is not annoying, that only certain ones become raucous and offensive. The problem is to find some way of changing those which are classed as "noises" into the sort of vibrations that command a goodly sum at the box office.



Courtesy Colorado Association

**Lizard's Head Peak, near Telluride, Colo. Although only 13,500 feet high, it has been scaled but few times, and then with the aid of steel pins driven into its rocky crest.**

Looking out of Box Canyon, Ouray, Colo.

# Switzerland's Rival, the San Juan Region

## *A Colorful Corner of Colorado which is Rich in Scenery and Mineral Wealth*

**ALLEN S. PARK**

TUCKED away in a mountain fastness of southwestern Colorado is an expanse of country which sends one who would describe its scenic grandeur to the dictionary in a fruitless quest of sufficiently expressive adjectives. It is better known to mining men than to tourists: for in this hurrying age few people will seek out hidden beauties just to look upon them, but men in search of precious metal will go to the ends of the earth.

This gem among the great West's copious wonderlands goes under the general name of the San Juan Region, which is also the designation given one of its principal mountain ranges. It encompasses some 2,400 square miles of land distributed among five counties. In point of time, it is almost as remote from Denver by rail as is Chicago. This, because the path the locomotive follows is necessarily long and tortuous to attain negotiable grades across the many mountains that intervene. Until recently it was almost as isolated to the automobile; but each year that passes brings improved highways, and even now there are those motorists who boast that they drive it between dawn and daylight.

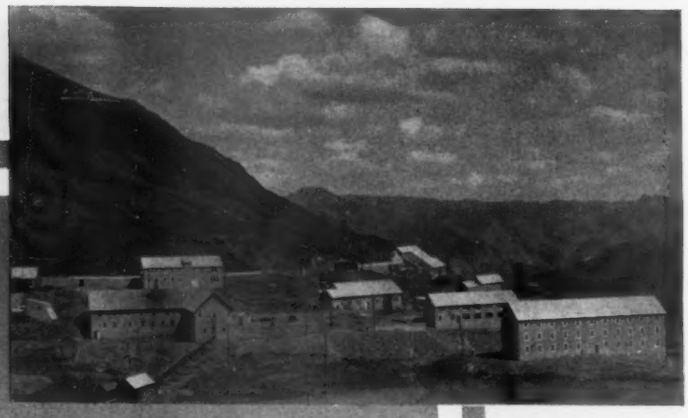
The San Juan country is distinctly a byway, though. Except for those who live there, few persons ever see it. If it were along a well-traveled route its charms would no doubt be extolled the length and breadth of the land. As matters stand, even good roads fail to attract more than a handful of speeding tourists each summer. From November to April, it is quite securely isolated. Often it is locked in by snowslides which block all avenues of ingress and egress. During the winter just past, a portion of the region was immured for more than a month and the scattered populace ran short of three essentials: butter, eggs, and dynamite. The few spots level enough for an airplane landing were buried beneath 30 feet of snow; and no one would hazard the dropping of eggs and dynamite from aloft.

This section of Colorado is historically the oldest in the state, and there is evidence to support the belief that it antedates any settlements by white men in California. Coronado either entered the region or passed close to it as early as 1540 while searching for the fabled "Seven Cities of Cibola". Half a century later, Juan de Oñate came up from Mexico at the head of a party of gold seekers. After a lapse of more than 150 years, Juan Rivera, a Spanish nobleman with a flair for adventure, led another quest for precious metal. Remains of placer workings credited to his party are still to be seen along the route. It is not of record that these men found much gold, but from the Sawtooth Mountains they are reported to have secured the prized seven-river jasper which was afterwards used in decorating the interior of the old cathedral in Mexico City.

The Spaniards left their impress upon the nomenclature of the region. San Juan, San Miguel, Montezuma, Conejos, Durango, Rio Grande, Dolores, Cortez, Mancos, Juanita, and many other place names bear witness to their early tenure of the area. They are particularly noticeable by way of contrast with designations in other sections of the state, such as Denver, Greeley, Washington, Jefferson, Gilpin, Adams, and kindred appellations which carry the stamp of the statesman, the empire builder, or the journalist. Still other parts of the state trace their orthography to the Indians and to the picturesque scouts and plainsmen such as Gunnison, Bent, and Kit Carson.

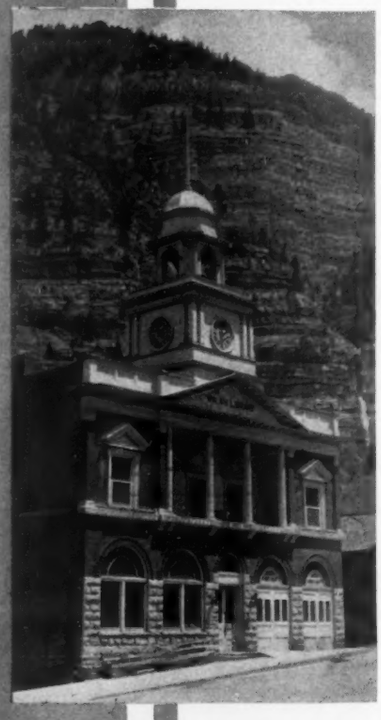
The first recorded white settlements in the San Juan Region were made by the Baker Expedition in 1860. The party suffered many hardships, and its ranks were decimated by Indian raids and starvation. They established Howardsville near the present Sunnyside Mill; and it became the first county seat with a log cabin for its courthouse. While excavating there for a cellar in 1919, Henry J. Forsyth found a Spanish coin bearing the date 1773.

Guarded as it is by sentinel-like peaks of 13,000 and 14,000 feet altitude, the San Juan Region was extremely slow in developing; and but for its mineral resources it is doubtful if much of it would even now be accessible. The building of roads was a herculean task;

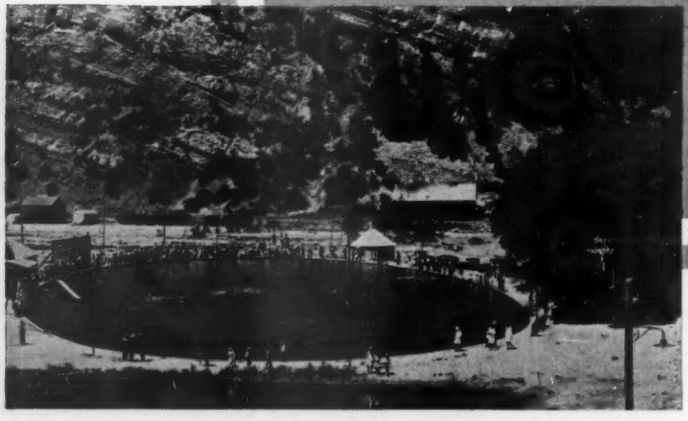


Sunnyside Mine, 13,200 feet high.

Ouray, rimmed by mountains.



City Hall and library, Ouray.



Bathing pool at Ouray.

**A group of views in the picturesque San Juan country. The central illustration shows the monument erected near Montrose, Colo., to the memory of the Ute Indian Chief Ouray and his wife, Chipeta.**

but the challenge was accepted by Otto Mears, who became the undisputed transportation king of Colorado. Between 1867 and 1886 he built nine wagon toll roads—many of them in this region—totaling more than 300 miles in length. Later he was the moving spirit in much of the construction of the Denver & Rio Grande Railroad, which reached Durango in 1881 and Silverton in 1882. The rail distance from Denver to Silverton is nearly 500 miles, although the two points are only about 200 miles apart as the bee flies. In 1888, Mears completed the building of a 17-mile, 5 per cent-grade railroad from Silverton northward to the flourishing towns of Red Mountain and Ironton near the crest of the divide between the Animas and San Miguel rivers. During one calendar year this line hauled ore worth $7,000,000. Its rails have long since been torn up, and both Red Mountain and Ironton are deserted.

Chief among the present San Juan towns are Silverton, Telluride, and Ouray. On the map they are relatively close together, but actually they are separated by lofty mountains which necessitate circuitous connecting highways. All are essentially mining camps. Each has seen its fortunes rise and fall, not once, but many times, as some new mineral strike revived it temporarily only to be inevitably followed by a period of lean production, rusting mine workings, and dwindling population. All have had their days of great opulence and their nights of champagne drinking. Some enviable fortunes have taken root in them. As in old mining camps everywhere, the grayheads spin delectable yarns of the plenteous times that have passed, assure you that they will return, that even now there are unmistakable signs that things are picking up in a mining way.

We do not wish to convey the impression that only ghost mines exist in the San Juan of today. On the contrary, a number of properties are working, and there is much mineral left in the ground that will no doubt give rise to some profitable ventures when base-metal prices stiffen. It is equally true, however, that the cream has been taken off and the days of bonanzas at grass roots are in that limbo of the past along with the roistering, care-free night life that characterized camps rolling in riches.

Those were the days when the Tom Boy and the Smuggler at Telluride were names symbolic of wealth; when the Camp Bird was pouring forth its seemingly inexhaustible largess; when 700 men worked in the Revenue; and when Ironton and Red Mountain, now tumble-downs, were communities of 2,000 souls each.

Half a score of mines had ore of fabulous richness. The Wheel of Fortune transported mineral by pack train to Lake City at a cost of $35 a ton, and the Yankee Boy paid $45 a ton smelting charges. Still they were able to show handsome profits. Ore that was richer than the average value treated profitably in the Black Hills of South Dakota was too lean to pay the heavy charges that ruled in this new Eldorado where most of the country seemed to stand on end.

Most enthralling of the countless stories that might be written is that of the Camp Bird Mine. Situated in the beautiful Imogene Basin near the foot of the 14,143-foot Mt. Sneffels, it is still profitably worked under lease, but yielding a mere pittance when one considers that its total production is estimated all the way from $25,000,000 to $40,000,000.

**Each winter, hungry mountain sheep come down from the high country into Ouray, where they are fed at public expense.**

Thomas F. Walsh, an astute businessman who emigrated from Tipperary County, Ireland, equipped by seven years' apprenticeship to follow the trade of millwright, made the Camp Bird. In return, the Camp Bird made Walsh an internationally known figure, a Croesus who dined with kings abroad and presidents at home. As a youth of nineteen, Walsh came to the United States in 1870 and spent a year in Worcester, Mass. Another move took him to Colorado, where he became a bridge builder for the Colorado Central Railroad. When the Government threw open lands in the San Juan Region for settlement, he went there in 1873, but the following year found him at Central City, a few miles west of Denver, where he put up some of the principal buildings in that then flowering gold camp. Already Walsh was dabbling in mining, and in 1876 the lure of gold sent him to the Black Hills. Two years later he was back in Colorado, at Leadville, where he joined others in purchasing and enlarging the Grand Hotel, at that time the leading hostelry of the thriving carbonate city which claimed eminence as the highest incorporated municipality in the world. Subsequently, he acquired many mines, but seems never to have settled down with any of them. For a while he ran the LaPlata smelter at Leadville, and then became manager of the Ironclad Mine at Ouray.

Whether true or not, a story persists that Walsh, after having accumulated a comfortable fortune, found most of it swept away in the panic of 1893 and turned again to the mining camps to recoup his losses. While operating a smelter at Silverton, he had the opportunity to study the ores from various San Juan properties. He was particularly impressed with the Camp Bird, so the tale goes, and, after making some investigations, bought it for a few thousand dollars. At any event, he acquired the property and developed it into a world-renowned mine. After taking millions from it, he sold it to an English syndicate in 1902 for $5,300,000. The Camp Bird's ratio of net profits to gross production is claimed to have exceeded that of any American mine of its time. Throughout many years of operation, the ore sent through the mill averaged $28 to the ton, mostly in gold.

That Ouray, which was his home for several years, might remember him, Walsh erected there in 1900 a public building which still houses the municipal offices. He personally selected the 2,000 volumes which formed the nucleus of the present library which occupies the second floor. Much larger cities would be glad to possess some of its books. For example, there is a complete set of the Edinburgh Review, which goes back to 1802, and another one of Punch which starts with 1841.

Having amassed a competence, Walsh traveled abroad, was entertained by the king of England and the king of Belgium. The latter gave his infant daughter, Evelyn, a solid-gold cradle. The daughter grew up to become Mrs. Edward B. McLean, wife of the Washington publisher. Tom Walsh, as he was known in Colorado, was in his later years elected to the United States Senate, where he acquitted himself with credit. At his country estate, just outside of Denver,

Courtesy Colorado Association

**The Camp Bird Mine, whence came the Walsh millions. From a generating station at Telluride, the Westinghouse Electric & Manufacturing Company strung wires across the lofty mountains to this mine in the first successful attempt at long-distance power transmission.**

he was host to William Howard Taft when the latter was president.

Aside from its mineral stores, the San Juan Region has little to offer one in the way of a livelihood, but it does contain superlatively beautiful scenery. Ouray and the surrounding section has been referred to as "the Switzerland of America", and some world travelers say that this phrase really fails to do it justice. Of the region as a whole, the historian Hall wrote: "Between Ouray and Silverton on the south, and Lake City on the southeast, the LaPlata Mountains present a scene of stupendous sublimity witnessed nowhere else upon any of the traveled routes of Colorado. It is beyond the power of words to describe, beyond the skill of painters adequately to portray. The spectator is simply lost in wonderment, filled with supreme awe of the marvelous power manifest in this mighty upheaval. Neither brush nor pen, however skillful, could more than feebly outline its glories. Other ranges have peaks as numerous and loftier, but none possess the rugged sublimity and variety of coloring found here."

From Ouray to Silverton runs the "Million Dollar Highway", so named because of its cost. Along a portion of its course it follows the gorge of the upper Uncompahgre River. Of this stretch of awe-inspiring natural excavation, there is handed down to us the following word picture by Lieutenant Marshall, who accompanied Capt. George N. Wheeler on his geological survey of the Rocky Mountains:

"The mountains, or rather the ruins bordering the gorge, especially on the western side, are simply indescribable. If the god of desolation ever exercised his wildest freaks on earth, he chose this spot, and cut the lofty masses into these strange forms and weird shapes, these yawning chasms with their red jaws, these beetling precipices with their plutonic brows, horribly frowning, capping all with slender columns and spires, under different angles of inclination to the horizon, which, projected against the sky, seem to be black figures of supernatural origin, dancing over the ruins below".

The occasional sight-seer who tarries long enough to investigate the hinterland is the one who really enthuses over the scenery. Trails lead in every direction and reveal much to reward the foot or horseback traveler who follows them. The whole region is a paradise for the mountain climber, and there are numerous peaks more than 14,000 feet in altitude to try their mettle. From Uncompahgre's 14,306-foot crest one may look into Arizona, New Mexico, and Utah. The lower slopes of the mountains are densely timbered with pine, spruce, and fir trees.

Ouray nestles in a natural amphitheater, rimmed on three sides by varicolored, horizontally disposed sedimentary rocks above which tower blue-gray igneous peaks. Hot-water mineral springs attracted the Indians there before a white man gazed upon the entrancing spot. Thanks to these springs, Ouray residents today enjoy open-air swimming even when the banks of the pool are piled several feet high with snow. Here, too, one is surprised to find an alligator, thriving in the tropical warmth of the waters 1,000 miles from a seacoast and 7,700 feet above tidewater. Formerly, two alligators shared their pond in domestic peace and contentment. After ten years of perfect amity, they suddenly started fighting, and now only the victor lies lazily in the pool.

Elk and Rocky Mountain sheep inhabit the surrounding heights, and in winter the snow drives them down to lower levels. Although there are fewer than 200 taxpayers in Ouray, by common consent a goodly portion of the town's treasury goes each winter to buy fodder for these animals. Hay is shipped in from the broad valleys below; and as many as 100 sheep are fed throughout the long months that the ground wears its mantle of white. Some of the accompanying illustra-

Courtesy Colorado Association

**Riders on Horsethief Trail, one of Colorado's oldest travel routes. According to a story that has been handed down, it was built by early-day horse thieves who stole horses in the San Luis Valley of Colorado and drove them overland to the Blue Mountains in Utah for disposal.**

tions show how tame these creatures become.

Ouray, curiously enough, is an Indian name, in contrast to the Spanish titles that characterize the rest of the region. It is a name that is revered by all who are familiar with the life and deeds of the great chieftain who bore it. Born in 1820, Ouray grew up to be one of the best-educated men of his race. He spoke English, Spanish, and many Indian dialects. When he attained manhood he was made chief of all the Utes. In 1859 he married Chipeta, known for her intellect and goodness. It was Chipeta who, at Ouray's behest, rode 160 miles on horseback in 1879 with orders that halted the White River Massacre and rescued the whites who were being held for ransom by renegade Indians. Ouray was always a peaceful chief and a wise leader of his people. He successfully negotiated with the Government at Washington for the sale of his tribal lands, and arranged for the money to be held in trust so that the income might help the Ute nation ever afterwards.

Ouray and Chipeta subsequently lived a few miles below Ouray, near the present City of Montrose, on land that the Government allotted them. A memorial park has been created there, and a mausoleum harbors the body of Chipeta, who died at the Ute Reservation in Utah in 1924. Efforts were made also to place the remains of Chief Ouray in the park, but his native people have refused to give them up.

Ouray died many years before Chipeta while at the Consolidated Ute Indian Agency at Ignacio, Colo., whither he had gone to confer with Buckskin Charley, one of his subchiefs. According to Indian custom, his body was secretly buried in the dead of night, and his grave was left unmarked. When, in 1925, citizens of Montrose sought to reinter the body in the memorial grounds, Chipeta's brother was sent as an emissary to the Utes at Ignacio. Many conferences were held, but the Indians were obdurate. They did, however, decide among themselves to move the body from its isolated grave among rocks to the regular Indian cemetery on the reservation. This was done on May 24, 1925, following a four-day ceremonial which included both Indian and Christian burial rites. The same four Utes who had carried the dead chieftain to the secret crypt acted as pallbearers at the reburial.

A controversy between tribesmen of Catholic and Protestant religious beliefs arose as to whose section of the cemetery should harbor the body. To satisfy both factions, the fence dividing the two portions was removed and the grave dug upon the line between them. Over the mortal remains of the great chief there flies an American flag, placed there by the Indians.

## TESTING WATER-TANK COATINGS UNDER SERVICE CONDITIONS

A LARGE water tank in Ambridge, Pa., is being made the object of an interesting test that should prove of value to water-works engineers. The Pittsburgh Des Moines Steel Company, in coöperation with the Borough of Ambridge, is using the tank to determine which of the available paints or compounds are best suited for covering the inside surfaces of steel tanks designed for the storage of water for domestic consumption.

The tank has a capacity of 1,000,000 gallons; and for this purpose the bottom and the inner surface of the shell have been divided into 196 strips. Each of these has been coated with a different material, including lead and oil paints, asphalt and coal-tar paints, aluminum paints, paints made of bakelite and of rubber, and enamels.

The tank is performing its regular function of supplying water to the community; but it is being emptied periodically to enable a committee of experts to inspect the numerous test panels and to rate them according to their condition. The ultimate findings of the committee are to be published upon the conclusion of the tests.

## DRILLERS APPLY HIGH-PRESSURE GAS TO RECOVER LOST TOOLS

OIL-WELL drillers usually work with their fingers crossed, so to speak, hoping luck will favor them and that they will not have a "fishing" job on their hands before they strike bottom. Stuck tools are the bane of their existence, because they can cause no end of trouble and their recovery frequently calls for much patience as well as ingenuity.

Fortune, however, did not smile on Fred Moore & Sons, contractors, while they were engaged in drilling a hole for the Emerald Oil Company in Perry Township, Ohio. When the drill was down 370 feet the wire line broke a few feet above the splice which connected that line with the manila cable. As a result, there was left in the hole not only the entire set-up of tools but 125 feet of the cable. With the exception of 30 feet of drive pipe, the drilling was being done in an open hole into which water flowed freely at a depth of 160 feet, where a porous water-bearing stratum had been encountered. When the mishap occurred the water had a head of more than 100 feet.

The drill, according to *The Petroleum Engineer*, had been churning the Injun or Blackhand Sand of the Mississippian Series from the time it was 20 feet in the formation—the sand being of a kind that settles rapidly after being penetrated, and in which lost tools are held as if cemented. From 8 to 10 feet of the sand packed around the bit and the box of the stem. In such circumstances the tools are usually recovered by flooding, or by what is known as "drilling by"—that is, putting a hole down alongside the stuck tools with a reamer bit. Flooding is effected by running down over the tools a string of casing in which a suction is induced by the use of a swab. The suction causes the sand to circulate, thus breaking its grip upon the tools so that they can be carried to the surface with the water. It was after both of these methods had been tried unsuccessfully that Fred Moore bethought himself of a nearby gas well with a rock pressure of 800 to 1,000 pounds per square inch. It was decided to tap this, and to use the pent-up energy to recover the lost tools.

A 2-inch line was laid from the gas well, which was about a quarter of a mile from the drilling site, to within 6 inches of the bottom of the hole so that the gas pressure would encounter no resistance. The piping was so arranged that it could be raised and lowered in the well. To quote Mr. Moore and Dr. E. V. O'Rourke, Professor of Petroleum Engineering of the Ohio State University, "Mud, water, and sand were thrown out of the hole upon opening the gate valve at the well. After the gas energy had been expended, the drillers were able to lower the pipe 1 foot. The process of blowing with gas was repeated eight times, with the gate at the gas well open for a minute each time; and intervals of 45 minutes to an hour were allowed the gas well to regain maximum rock pressure. After each trial the pipe was lowered from 6 to 12 inches.

"Immediately after the operations just described, the 2-inch tubing was pulled out and the tools were strung up. A 10-inch slip socket was used, and no difficulty was experienced in obtaining a fast hold on the lost tools. The cable was put under an upward strain and gave evidence of moving—it was unnecessary to use a jarring action. On 'backing down', the tools dropped back. The cable was lifted in this manner several times, tending to loosen the tools from the sand. In fifteen minutes after the hold had been secured, the lost tools were completely freed and drawn from the hole.

"The writers believe that similar fishing jobs could be carried out successfully by the use of compressed air, furnished by a portable compressor, in case high-pressure gas is not available."

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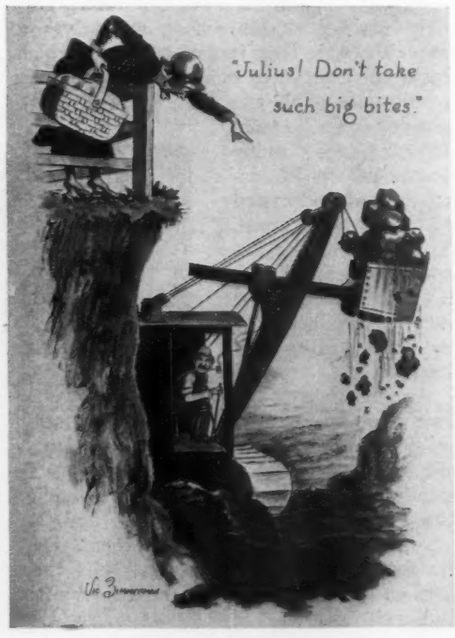
## MEXICO CITY BUILDING FIRST SKYSCRAPER

A STRUCTURE thirteen stories high may not be a skyscraper to a New Yorker but it is to the resident of Mexico City where, because of the instability of the ground, buildings are inclined to be spread out and low lying. It will be recalled that Mexico proper, although 7,500 above sea level, is situated on what was once the bottom of a lake. Considerable interest is therefore being manifested in the capital's first skyscraper. It is to be equipped with a modern ventilating system, elevators of the latest type, in fact, is to be up to date in every respect.

The steel-and-concrete structure is being built on a foundation of reinforced concrete on wood piles. There are 373 of these, each 12 inches in diameter and 110 feet long, giving a supporting area of 7,879 square feet capable of bearing a unit load of approximately 2,540 pounds per square foot. The structure has been designed to withstand earthquake shocks with a maximum acceleration of 2.13 feet—the horizontal thrust in that case being calculated as equivalent to 670 tons or one-fifteenth of the total weight of the building.




## LEATHER BELTING IS NOW SOLD BY THICKNESS

FOR the added protection of the consumer, leather belting is in future to be sold by thickness instead of by weight, as has been the practice for many years. When ordering, the purchaser will no longer specify leather of so many ounces per square foot, because the weight can easily be varied by the addition of weighting materials and for that reason, according to the American Leather Belting Association, does not necessarily represent a differential in transmission values.

Before coming to this decision, the association canvassed all leather-belting manufacturers in the United States with the result that 81 replies were received, all voting in the affirmative. It can therefore be said that the movement for higher standards has the endorsement of the entire industry.

The thickness specifications now in effect for first-quality leather belting are as follows:

| | |
|---|---|
| Medium Single | 10/64 to 12/64 in. |
| Heavy Single | 12/64 to 14/64 in. |
| Light Double | 15/64 to 17/64 in. |
| Medium Double | 18/64 to 20/64 in. |
| Heavy Double | 21/64 to 23/64 in. |

1. All thicknesses in this table are average thicknesses in inches, and should be determined by measuring twenty coils and dividing this value by the number of coils measured. In rolls of belting containing less than twenty coils the average thickness should be determined by measuring one-half the total number of coils and dividing this value by the number of coils measured.

2. The classification of "Light Single" has been eliminated.

3. Uniformity—No point in either single or double belting shall be more than 2/64 inch thicker or more than 2/64 inch thinner than the average thickness.

4. The second- and third-quality brands of each manufacturer bear the same relative thickness to the manufacturer's first-quality grades as they did in the past under the ounces-per-square-foot specification.

These thicknesses are now in effect and should be used by all buyers. Every order for "Single" or "Double" belting should specify the thickness. If just the words "Light", "Medium", or "Heavy" appear, they are now interpreted as meaning thickness according to the foregoing table and not weight, as was formerly the case.

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What the engineers of the Panhandle Eastern Pipe Line Company call "spare tires" have been set up alongside that company's 1,100-mile pipe line extending from Texas to Indiana and Kentucky. These spare tires consist of two lengths of pipe—a 20-foot and an 8-foot joint, and are 24, 22, or 20 inches in diameter, depending upon the size of the particular section of the system they parallel. They are mounted on stands placed at 20-mile intervals, and are complete with couplings and clamps which are tack welded to the pipe to prevent theft. The object of these spares is to enable the company to repair without delay any of the ordinary breaks that occur in gas lines.

# Packing Coffee the New Way

Part of a coffee plantation in Sao Paulo State, Brazil, the richest coffee-growing region in the world.

Photos this page from Ewing Galloway

## *Vacuum Process Seals Natural Flavor in the Can by Excluding Oxygen*

C. H. VIVIAN

MORE and more the scientist is taking a hand in improving the food we eat. Only a few years ago the quality of the meals placed upon the dining-room table depended primarily upon the individual skill and knowledge of the person presiding over the kitchen. Although cooking is still one of the finer arts and probably always will be, much that formerly had to be done by the cook is now taken care of by the suppliers of foodstuffs. Canned and packaged goods of continually increasing variety now arrive in the kitchen with many of the intermediate steps between the stove and the table already performed. Not only is the quality of any one of these products higher as it now comes from the store shelves but the purchaser can rely upon that quality being uniform from day to day and from month to month. These things are true largely because technical men have shown the way to better processes of treatment—processes which are now standardized and which are carefully controlled and checked, step by step. In short, the preparation of foods in homes, restaurants, and hotels is becoming easier and simpler all the while because of what goes on in laboratories.

Of recent years the chemist has turned his attention to coffee, and he has found out some surprising things. Most important of all, he has learned what causes coffee to lose its freshness. And, having determined that, he has been able to devise means to pack it so that it will retain its freshness for a period of several months. In other words, he has discovered a method of preparing and preserving coffee that insures it reaching the consumer with its full strength and flavor intact. As a result, the coffee drinker can now have a better-tasting beverage and one that has a uniform flavor, day after day.

When scientists began to delve into the subject, they found that certain definite changes take place in the coffee bean when it is roasted. Of chief interest in connection with the subject under discussion is the fact that large quantities of carbon-dioxide gas are generated and that this gas, along with small amounts of other gases, is intimately imprisoned, under high pressure, in the cell structure of the bean.

Miss Bettina Hall, a winsome star of the theater, enjoying her morning coffee.

Liberation of this gas causes coffee to lose freshness and to acquire staleness. The reason for this is that when the carbon dioxide leaves the coffee its place is taken by air. The oxygen contained in the air then sets to work. The process of oxidation begins. This gradually changes the chemical composition of the coffee. The volatile oils and other ingredients that impart flavor are altered. The delicate aroma of fresh coffee disappears. In the place of freshness and tastefulness come staleness and bitterness.

It is important to understand that these things can happen to coffee only after it has been roasted. In its green or raw state the bean can apparently be kept unharmed for a long time. The heat of roasting causes chemical changes within the bean that create both the characteristic flavor and also the carbon dioxide which protects and preserves that flavor as long as the gas is retained under its original pressure. Since it is under pressure, however, the carbon dioxide exerts a tendency to escape. Even in its bean form, roasted coffee loses half its contained gas in about a week. When it is ground, the diffusion is accelerated by the breaking down of the cell structure, and half the gas escapes within 48 hours. Because of these facts, research has shown that coffee which is exposed to the air must be used within two or three days after it has been roasted if the drink made from it is to have its full flavor and that indescribable quality which we call freshness.

It is evident from the foregoing explanation that to preserve the true flavor of roasted

Ewing Galloway

**The central picture shows a branch from a coffee tree bearing the growing beans. The upper inset is a view in the roasting room of the Maxwell House coffee plant in Brooklyn. The roasted beans are cooled in the vessel in the foreground. After being roasted the beans go to the grinders shown in the lower inset.**

**Left—The cans of coffee coming from the closing machines enter a main conveyor line which moves them to the shipping department.**

coffee it is necessary to keep the carbon dioxide imprisoned within it. This is accomplished by packing it within cans from which virtually all air has been exhausted. In effect, the carbon dioxide is kept within the coffee by excluding all other gases from the container. In commercial channels this process of packing is called the vacuum pack.

Vacuum packing of coffee is not new; but it has today reached a higher efficiency than ever before attained. A coffee roaster discovered back in 1899 that his product kept better if he packed it in cans from which much of the air had been excluded. He probably didn't know just why this was so. At any rate, although he applied the principle, he applied it only partially. That is to say, the methods and machinery he employed were not sufficiently developed to produce the degree of vacuum which can now be obtained.

As the importance of keeping air away from ground coffee came to be more generally recognized, most of the large coffee roasters enlisted the aid of scientists to ferret out why this is true and what happens inside the bean after it is roasted. As a result of their findings, there are various vacuum-packed coffees on the market today. All concerns employing vacuum processes aim at the same purpose. The extent to which they do this depends upon the thoroughness with which they exclude air from the can. This, in turn, rests upon the efficiency of the technical and mechanical means which have been set up to handle the packing.

Among the foremost exponents of vacuum-packed coffee is the Maxwell House Products Company, Inc., which is a division of General Foods Corporation. Maxwell House Coffee, long a favorably known brand, is packed by what its producers have termed the Vita-Fresh process. This method, which calls for the use of highly ingenious machines, is in large part the accomplishment of Thomas M. Rector, chemical engineer of General Foods Corporation. Following exhaustive laboratory investigations, Mr. Rector saw that the closer he came to obtaining a complete vacuum within the can the better and longer the coffee could be preserved. He accordingly strove to exhaust as much of the air as possible within the limits of commercial operating conditions. As a result of these efforts, the Vita-Fresh process has been so developed that it is said to bring about the withdrawal of approximately 99 per cent of the air from the container. Just how great an advance this is can be realized when it is stated that until comparatively recently a 90 per cent vacuum was the highest utilized for this purpose.

To add clearness to the picture, the Vita-Fresh process will be described in its regular place in the coffee-packing activities of the company as practiced in Brooklyn at the largest of its five plants. The Brooklyn plant can roast and pack 170,000 pounds of coffee in a working day of 8¾ hours. When occasion demands, the production can be increased as desired by extending the hours of operation. Considering the work it does, the plant is remarkably compact, being housed in a 6-story building of moderate size. Storage facilities for cans, raw coffee, and finished coffee are limited to little more than a day's supply and output, so that the activities comprise a continually moving spectacle of working materials going in and cartons of the finished product coming out.

The principal steps in the process are cleaning the green coffee, roasting, grinding, and packing. Gravity is utilized for transportation wherever possible and, in general, the material flows from the sixth floor to the first

Courtesy Jabez Burns & Sons, Inc.
**Cross-sectional view of a modern coffee roaster.**

floor during its course of treatment. The time required to convert the raw coffee into the finished product, ready for shipment, is 1¾ hours at the most. The greater portion of this period is devoted to operations while the coffee is unroasted. This means that less than an hour elapses after the coffee leaves the roasters until it is sealed within its protecting containers.

Green coffee, packed in bags weighing from 132 to 150 pounds each, arrives from Brazil, Colombia, Mexico, and other coffee-growing countries by boat and is trucked a short distance from the dock to the plant. A special elevator, having metal arms on which the bags rest, conveys them to the sixth floor at the rate of eight a minute. The bags are then opened and their contents dumped into a bin which feeds the beans to a cleaning device. This is a sloping, vibrating metal table having round perforations graduated from small to large size. Dirt, dust, and other bits of foreign matter fall through the smaller openings. The coffee travels on to the zone of larger holes, where it, too, passes through the plate and into bins. Scraps of hemp and string from the bags move on across the table and are thus excluded.

Bucket conveyors next elevate the beans to a point where measured portions of different varieties are directed into blending tumblers, which are large metal cylinders. The proportions in which the several kinds of coffee are to be mixed are given the men in charge by experts in the buying department.

The cleaned coffee goes to the roasters, of which there are sixteen. The roaster is essentially a horizontally arranged metal cylinder having a central opening at the back through which is directed a gas-air flame. Within the outer cylinder is a second one which rotates slowly. Spiral vanes disposed about the inner surface continually lift and mix the beans. When they reach a point near the top, they fall upon a metal "spreader", shaped like a gabled roof, which protects them from direct contact with the flame. The beans flow in a continuous stream down the sides of the "spreader" and fall to the bottom of the cylinder, to be again elevated by the blades. Smoke, steam, and chaff are carried off through perforations in the inner cylinder by an induced air current. The front of the cylinder has a square opening through which the progress of the roasting can be observed. It takes approximately twenty minutes to complete a roast; but time is not the governing factor in determining when a lot is completed. Skilled attendants gauge this by the color of the beans and by certain changes in their general appearance. The coffee bean swells slightly during the roasting, and irregularities in the skin are smoothed out. The eyes of the observers are so trained that coffee is seldom over-roasted.

If the roasted coffee is not cooled uniformly it becomes spotted. To insure even cooling, it is taken directly from the roaster to an adjoining cooler. This is a round, metal vessel, open at the top and having rotating stirring arms arranged around a central vertical axis to continually mix the beans. Meanwhile a current of air is drawn through the mass and out through perforations in the bottom. The air current is provided by a suction fan.

From the cooler the beans go to an apparatus known as a stoner. This is a gravity-separation device which removes stones, nails, and bits of metal which were not taken out when the green beans were cleaned. A current of air floats the coffee, while the heavier materials separate out and fall down a vertical chute.

The coffee is now ready for grinding. This is accomplished by passing it between two horizontal metal rolls, each 30 inches long and 6 inches in diameter. Both rolls have fourteen surface corrugations to the inch, and these run longitudinally on one cylinder and circumferentially on the other. The rolls are spaced about four or five thousandths of an inch apart. Practically all the product is reduced to the desired size, but oversize material is rejected by a screen and is recirculated through the rolls. From the grinder,

**Empty cans are fed in at one end of the plant as shown in the upper view. Filled with coffee, they emerge in cartons.**

or granulator, as it is known, the coffee goes to storage bins which are designed so as to prevent segregation of the fine from the coarse particles as the material passes through them. Coffee for the packing room is drawn from the bottoms of these bins.

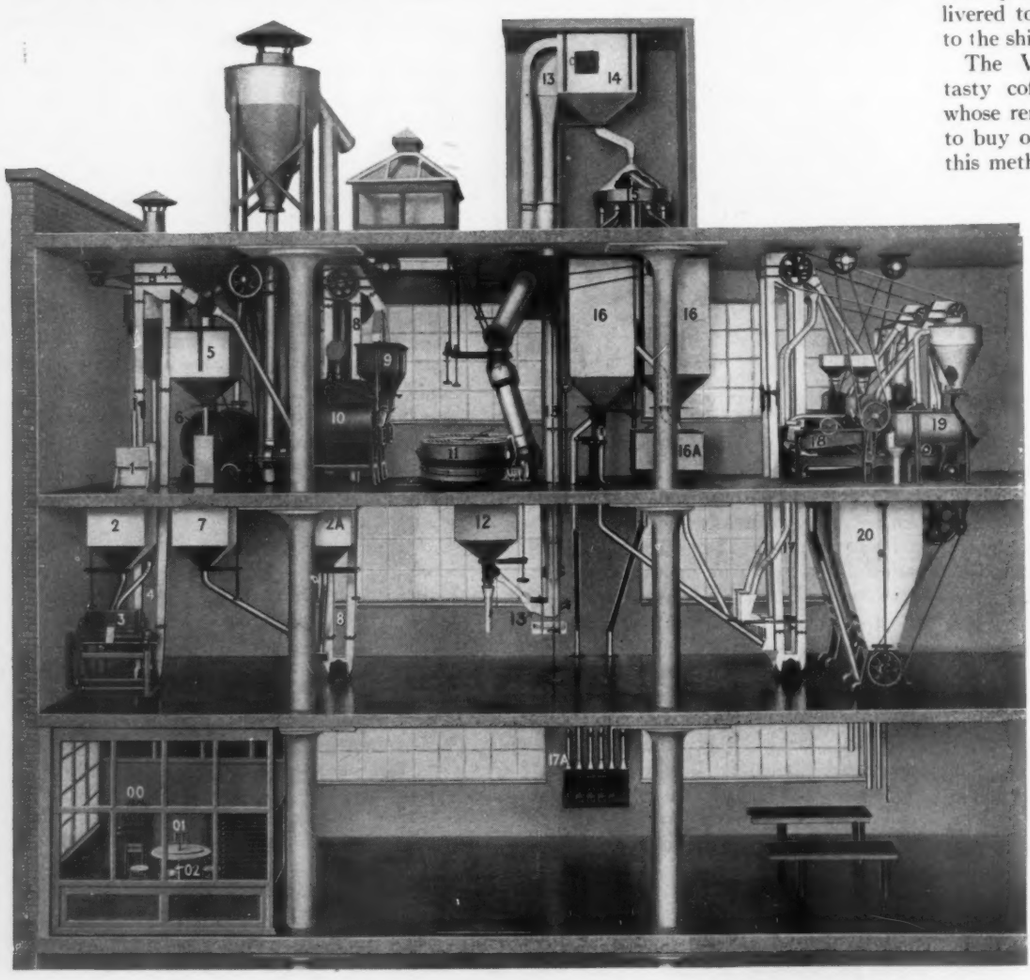
The packing operations are automatic. Cans, which are received wrapped in lots of 120, are fed upon runways by girls who have become so adept that they handle them at the rate of 130 a minute. These runways convey the cans to the packing department, where they enter the lines leading to the filling and closing machines. Each line has the form of a flattened and elongated letter "U". Each can stops at a filling station long enough to receive its contents, which are automatically weighed. A little farther along a cover is placed upon the can and lightly crimped in position for final sealing. The can then passes along to the mechanism which removes the air and fastens the lid on tightly.

This all-important apparatus is known as the high-speed vacuum-can-closing machine, and is the product of the American Can Company. It consists essentially of a central vacuum chamber containing the can-sealing equipment, and of rotating entrance and discharge valves. It was found that it was not practicable to obtain the desired degree of vacuum in the central chamber, alone, because of the large volume of air admitted to this chamber when cans entered or left it. The revolving valves, under partial vacuum, were accordingly designed to assist in the process. They have pockets which carry the cans, through a seal, into and out of the higher vacuum of the central chamber. Immediately following the exhaustion of its contained air in the central chamber, the can is hermetically sealed. The principal sources of vacuum for the closing machines are three Ingersoll-Rand Class ER-2 vacuum pumps. These units are of the straight-line type, and each has one 22x9-inch, 2-stage cylinder. Each pump is driven by a short belt from a General Electric 30-hp. motor.

A closing machine of the type described will evacuate and seal 1-pound cans at the rate of 60 a minute. In the Brooklyn plant there are six of them, as well as a seventh unit that handles 3-pound cans at the rate of 30 a minute. By making a few changes, the 1-pound machines can be adapted to handling half-pound cans.

Filled and sealed cans from the various closing machines move on to a main line which conveys them to machines which pack them in cartons. The latter are so efficient that two of them can handle the entire production. The filled cartons are carried through other ingenious devices which close down the top flaps, seal the boxes top and bottom, and stamp a code number on the side of each. Thus packaged, the cartons of coffee are delivered to a conveyor belt which takes them to the shipping room.

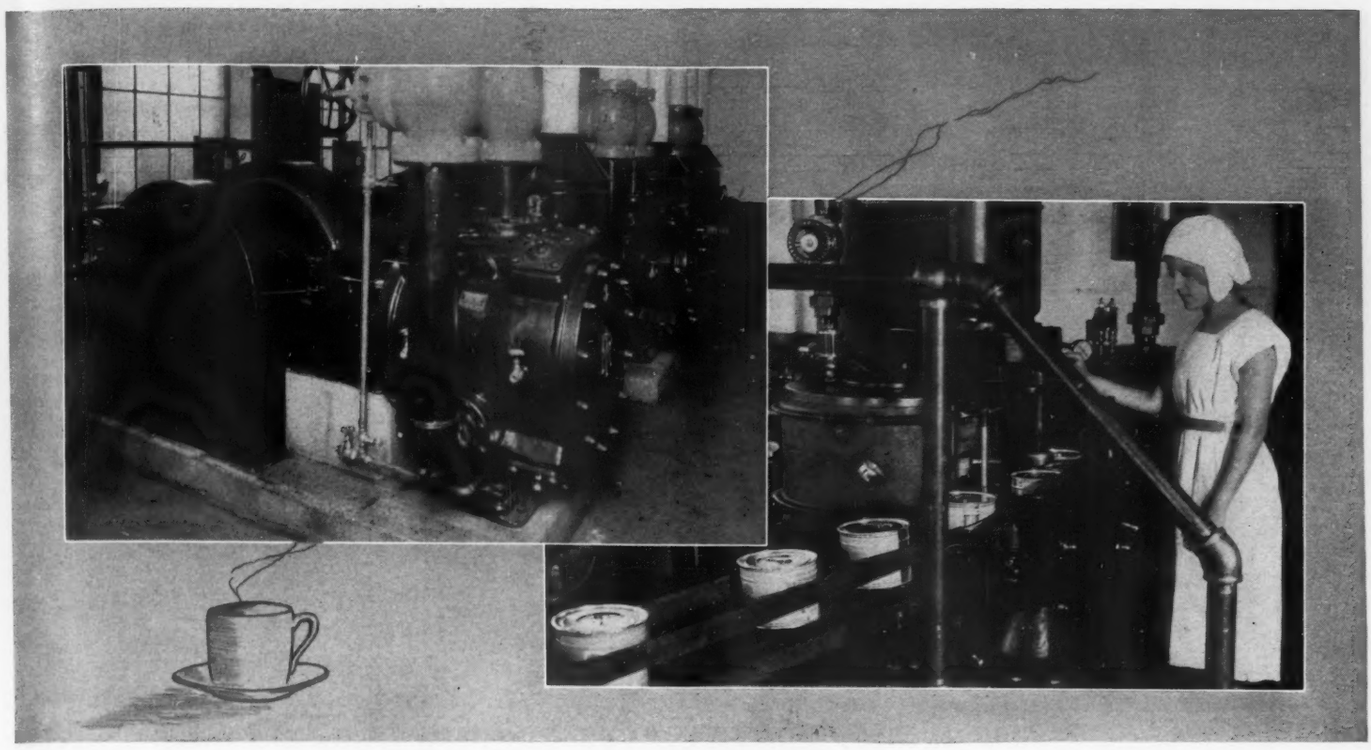
The Vita-Fresh process provides fresh, tasty coffee to rural residents and others whose remoteness from markets causes them to buy only occasionally. Coffee packed by this method will stay fresh in the can for at




## MODERN COFFEE ROASTING PLANT

1—Dust hood over chute to bin 2
2—Dump bin over sifter
3—Sifter for cleaning green coffee
4—Bucket elevator to bin 5 or 2A
5—Bin feeding 6
6—Green-coffee mixer
7—Discharge bin for 6
8—Bucket elevator to roasters
9—Feeding bins for 10
10—Two roasters
11—Two coolers
12—Cooler floor hopper
13—Stoner boot and riser
14—Stoner hopper
15—Distributor
16—Roasted-coffee bins
16A—Coffee transfer car
17—Elevators to granulators
17A—Bagging spouts
18—Granulators
19—Normalizers
20—Ground-coffee bins
00—Sample roaster
01—Revolving table with scale
02—Waste vessel

Courtesy Jabez Burns & Sons, Inc.



**The three 2-stage vacuum pumps which are of vital importance in the process are shown adjacent to a close-up of one of the high-speed closing machines which exclude the air from the cans and seal them at the rate of one a second.**

least a year. Under "blind" conditions, professional coffee tasters have been able to detect loss of freshness in nonvacuum-packed coffee in from three to five days after roasting and grinding. They also have definitely identified high-vacuum-packed coffee as superior in freshness to low-vacuum-packed varieties within two weeks after roasting and grinding.

Some air remains in the can even after high-vacuum packing, but the amount is so small that its effect is negligible. The space formerly occupied by the withdrawn air gradually fills with carbon-dioxide gas, which escapes from the coffee. Within a few days the gas pressure in the can very nearly balances that within the coffee, and it also just about equals the normal atmospheric pressure outside the can. Chemists have determined that some of the flavor and fragrance of the coffee is carried along with the carbon dioxide, which eventually fills the can. However, since coffee has the property of absorbing flavors to which it is exposed, it reassimilates them, and this time they remain in the coffee because the gas pressure within the can is balanced and the gas no longer has a tendency to escape from the coffee.

The high-vacuum-packing process is in itself more costly than earlier methods, but it is productive of various economies. Because Vita-Fresh coffee can now be transported great distances without losing its freshness, the company has been able to reduce the number of its packing plants in the United States and Canada from eight to five. Plants are now maintained in Brooklyn, Houston, Jacksonville, Los Angeles, and Montreal. All are served by direct ocean-freight connections. Since roasted coffee weighs 15 per cent less than raw coffee, the closing of the inland packing plants has resulted in saving some of the freight charges on coffee previously supplied the trade from those points. It also has made possible more carload shipments than formerly and has done away with some "back-hauling". The concentration of production in five plants instead of eight of course effects economies in general overhead expense and has released a considerable fixed-plant investment. The new process also permits plants to carry small working stocks and to smooth out the production curve, with the accompanying elimination of overtime on the one hand and irregular employment of labor on the other hand.

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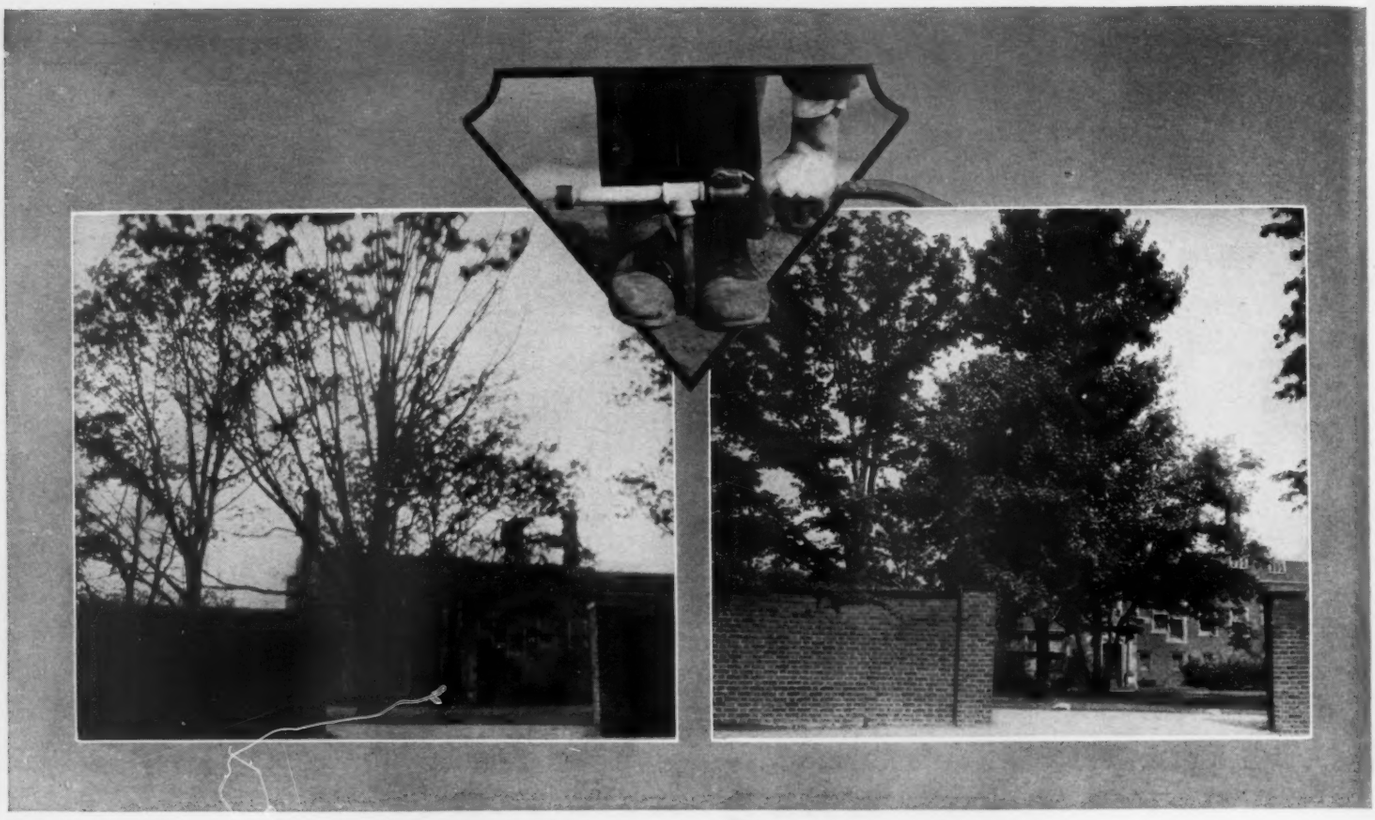
### PNEUMATIC PIPE CONVEYORS WITH WEAR-RESISTING BENDS

BENDS in pneumatic pipe-conveyor systems are subjected to more or less wear and tear, depending upon the velocity of the flow through the line, the radius of the bend, and the nature of the material being handled. To offset this so as to prevent frequent replacement, the steel bends are being either reinforced or are made of pure rubber hose having a wall thickness of from 3/8 inch to 1/2 inch and protected by a wire-and-fabric sheathing. For additional support, the hose can be clamped to a piece of channel iron. As the outer side of the bend is generally the only part affected, the hose can be turned 90° three times before it has to be discarded. Rubber hose of this description has been found effective in transporting lump lime, bauxite, salt cake, and any other bulk commodity that comes under the heading of mildly abrasive, through high-vacuum pneumatic conveyor systems.

For more abrasive materials it is necessary to give the bends a reinforcement. This is in the form of what is termed a wearing box—a steel container that is welded to the underside of a bend and may or may not be subdivided. In the case of a conveyor used to carry pulverized clinker from an ash pit to a storage bin, the steel bend has been supplemented by such a box with several compartments. When the wall of the pipe proper is worn through, the box fills with ash, building up a cushion that is from then on exposed to the abrasive action of the ash in transit—the partitions helping to keep the container well packed.

Another bend of the same order is giving satisfaction on a conveyor that handles 20 tons of ground phosphate rock an hour throughout the 24 hours of the day. When in place, the box is filled with concrete through an opening that is later sealed with a metal plate. On its way through the line, the phosphate rock soon cuts a hole in the pipe at the bend. This hole, together with the hollow next worn in the concrete, is progressively enlarged until the cross section at that point is of such a size as to induce deposition of the material and filling of the box, with the results as previously mentioned. In both instances cited, the life of the bends has been lengthened appreciably, but at some loss in power through eddy currents caused by the increase in cross section.



**Left—Trees made unhealthy by packing clay over their roots. Right—The same trees two years later, their vigor restored by aeration. Insert—Using the Irish patented gun for introducing compressed air into the soil.**

# Rehabilitating Sickly Trees with Compressed Air

TREES, like human beings, must have proper and adequate nourishment to live. If some of the essential items of food are removed from their diet, or are reduced substantially in amount, the trees become unhealthy. Unless these deficiencies are corrected, the trees eventually die. In effect, they starve to death.

To quote a prominent authority on tree culture, "A tree requires ten elements if it is to thrive. It takes one of them—carbon—from the air, and nine from the soil. Six of these are found in every soil, no matter how poor; but some that are absolutely essential to plant life—notably nitrogen, phosphorus, and potassium—are soon exhausted unless replaced by spreading decaying vegetable matter on the surface. In their natural state, trees are fed by the decomposition of dead leaves about their bases, but in parks and in other city locations, where leaves are regularly raked up, these food elements are not returned to the ground."

In short, modern city life takes a heavy toll of tree vitality. Fortunately, municipalities and other owners of numerous trees have come to realize their aesthetic and utilitarian value, and are now looking after their health in a very careful and systematic manner. Specialists in this rehabilitation work are to be found in every large community, and they have achieved some remarkable results in transforming ailing trees into strong and vigorous ones. In brief, they feed the trees those elements of which they have been receiving insufficient amounts. They also restore soil conditions as closely as possible to their natural state in order that the trees may again obtain, in a natural way, a complete and well-rounded diet. In all this work, a new technique has been evolved in which compressed air is one of the most important agencies.

Among the firms that are doing noteworthy things in this tree-saving profession is Chas. F. Irish Company, Inc. of Cleveland, Ohio. A method of aerating the soil around the roots of trees, invented by Mr. Irish, has proved so effective that improvement in the color of the leaves is visible in some cases within 48 hours after treatment. We are indebted to Mr. Irish for the following discussion of the work he is doing.

Compressed air is an efficient and economical aid in correcting the insanitary or toxic conditions which frequently develop about the roots of trees, in addition to supplying the roots with oxygen and establishing a condition which enables the roots more readily to obtain the oxygen which they require for normal growth. Trees, in common with all living things, need oxygen in order to carry out their respiratory processes. Since oxygen makes up one-fifth of the atmosphere, it has been generally assumed that it is a simple matter for all trees to help themselves to whatever of this vital element they must have. While they are able to obtain enough oxygen to supply their aerial parts—leaves, branches, and trunk—the artificial conditions created by men along highways, in parks, and on estates prevent the necessary quantity of oxygen from penetrating the soil around the roots.

These artificial conditions are: the impacting of the soil above the roots and the partial covering of the root areas with impervious pavements. In addition to shutting off the normal flow of oxygen, which is needed not only by the roots but also by the desirable soil bacteria, these conditions retard or prevent the escape of the by-product gases of the respiratory processes of both the roots and the bacteria. The accumulation of these gases about the roots produces a condition toxic to them. If mild in form, this may only retard the growth of the roots; but if permitted

to become more concentrated it will finally kill them.

In his successful method of counteracting this condition, Mr. Irish bores holes into the ground at intervals of 30 inches, the various holes describing one or more circles about a tree so as to cover the entire area beneath the branches up to within a few feet of the trunk. The distance away from the trunk to which the holes extend will, of course, differ with the size of the tree. Under average circumstances, the depth of these holes is from 15 to 18 inches, but the penetration is determined largely by the character of the soil. The holes are bored with Ingersoll-Rand Type DDE air drills, the power being furnished by a Type 20 portable compressor.

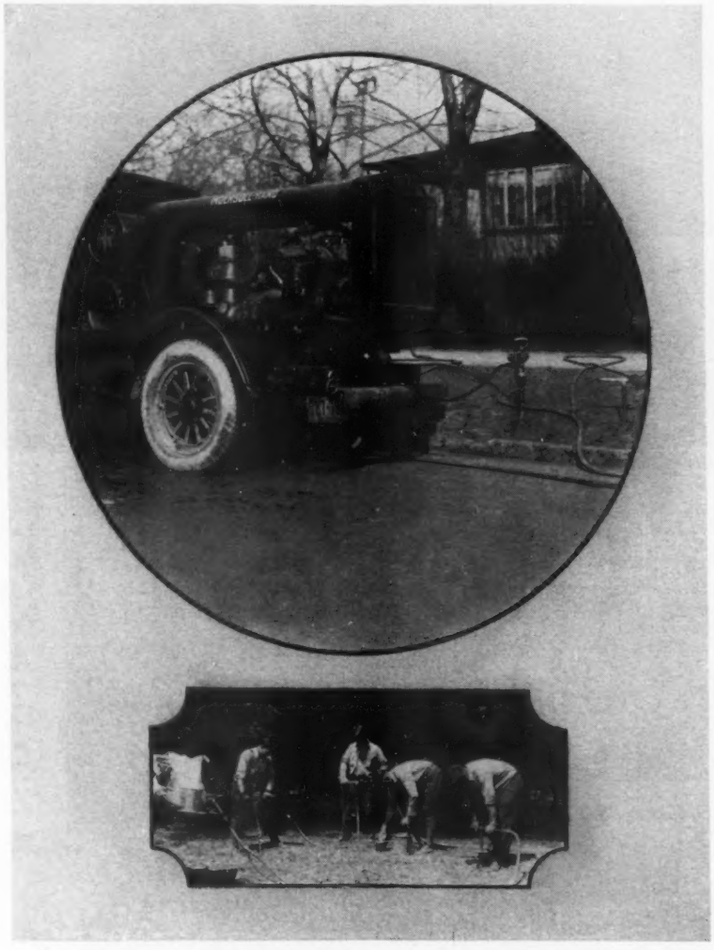
After the holes are drilled, compressed air is introduced into them through a patented self-tamping gun. For this phase of the work a pressure of at least 100 pounds to the square inch is desirable. The air has the effect of fracturing the hard soil—the cracks, in some cases, reaching out several feet. Air escaping from the nozzle through these fractures drives out the soil gases and impregnates the ground with a supply of oxygen which serves to stimulate the roots of the trees and the beneficial soil bacteria. The breaking up of the soil renders it more porous, which permits a continued diffusion of the gaseous by-products produced within it as well as the ready penetration of oxygen. Thus it is possible to establish growing conditions similar to those of the natural forest or to those of our garden crops induced by cultivation.

The beneficial effect of this aeration is further increased by the blowing of fertilizer through the fractured soil. This places it close to the roots, whereas surface applications benefit the lawn primarily. This is especially true of phosphorus and potassium, which are shown by tests to remain within an inch or two of the level at which they are introduced into the soil.

This method of improving soil conditions around trees has worked successfully in cases where the smaller roots up to 2 inches in diameter have been killed and turned blue by gases. Under such circumstances, successive treatments are advisable and will have the effect of converting toxic, ill-smelling ground into a sweet and productive soil in which the roots can thrive. This process is said to represent the first real improvement in fertilizing ornamental trees since Austen, in 1657, described a way of working plant food into the soil with a crowbar; and it is more economical than any method of application previously practiced.

In Central Park, New York, compressed air has been used in work of this nature for several years. At the outset, the city purchased an I-R 4¼x4-inch Type 20 portable air compressor, which provided power to operate two Type DDW woodborers. Holes are drilled in a manner similar to that described, and these are then filled with concentrated fertilizer. With this equipment it is possible to do in a few months work that would require a period of years by hand methods. It was found, moreover, that the over-all cost of treating those of the trees in the park that required such attention, and which would otherwise have died, was less than would have been entailed had they been uprooted and hauled away.

Boring and aerating the soil has been successfully used by Chas. F. Irish Company, Inc., for locating leaks in gas mains. By its method the gas is driven out of the soil so rapidly that small quantities of it are readily traceable to their source. In one case, where ordinary means failed to reveal them, 120 leaks were detected in approximately two miles of lines.



**In the circle is a portable compressor used in arboreal work. Below, workmen are shown performing various essential operations in the treatment.**

## SHEET COPPER PRODUCED BY ELECTROLYSIS

SHEET copper is being produced directly by electrolysis and on a commercial scale at the Raritan Copper Works, according to a recent announcement. The product is the outcome of years of experimenting, and is said to be free from pinholes and other imperfections and to have all the appearance of the rolled metal.

Sheets of any length within practicable limits are being turned out in widths up to 48 inches—the maximum obtainable with the equipment at present available. The thinnest of them is 0.0017 inch through and weighs 1 ounce per square foot. Sheets of such thinness can be rolled, but in widths of 6 inches only, so we are told. Other standard sheets made by electrolytic deposition on revolving cathodes are 2 and 3 ounces per square foot—7 ounces apparently being the economical limit of the process as now developed.

Because of their thinness and size, the sheets have already found a market and are being used to wrap underground oil and gas pipe lines so as to protect them against corrosion and soil stress—the smooth surface of the copper permitting the ground to settle without damaging the sheathing and exposing the underlying metal. They are also supplanting canvas as a covering for insulated piping in oil refineries. Backed with fabric, and applied with a suitable adhesive, they are recommended for structural purposes, as a roofing material, and for the making of automobile car tops. For this purpose the sheeting could be made to resemble leather by crimping and painting. These are but a few applications; and many are predicted for these thin sheets of copper that have been made possible by electrolysis.

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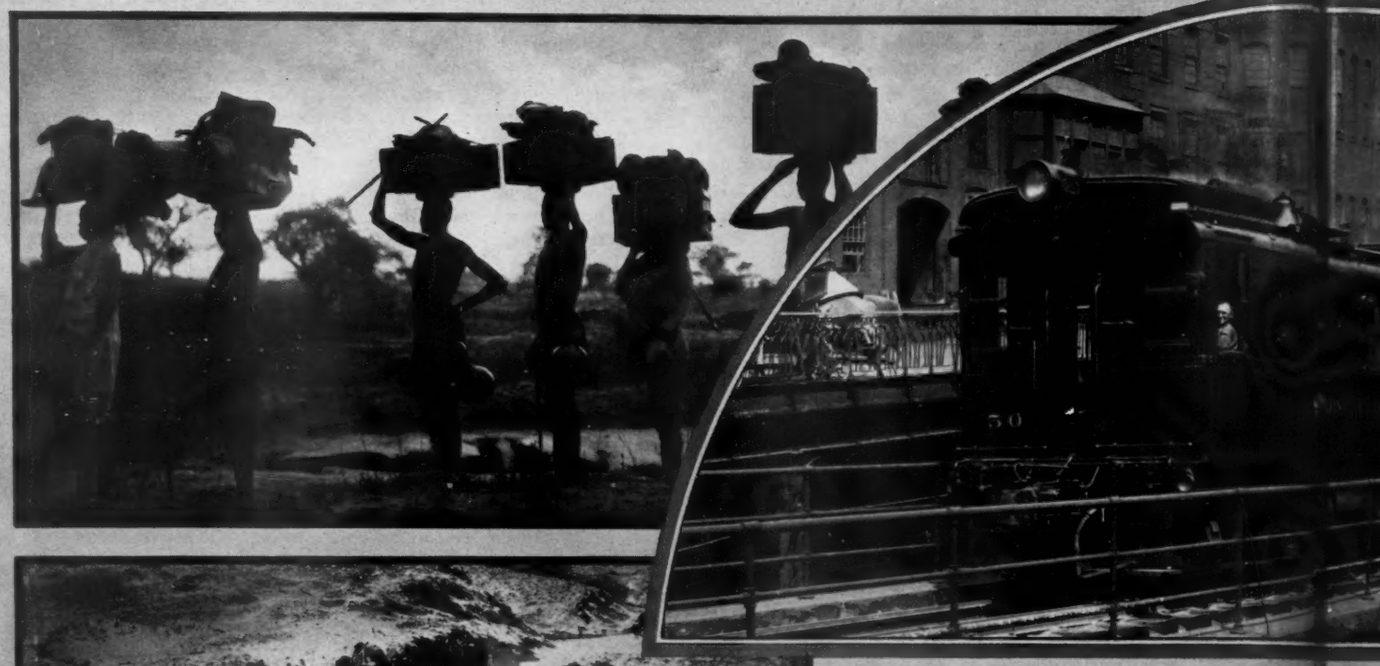
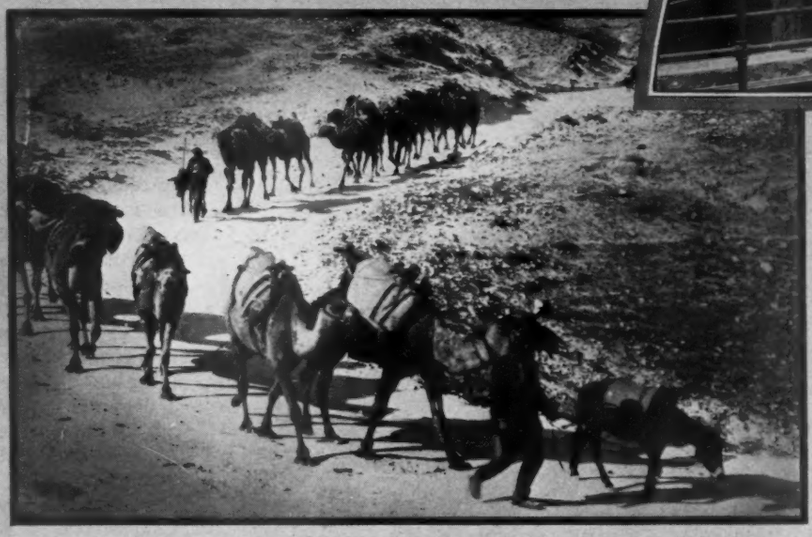
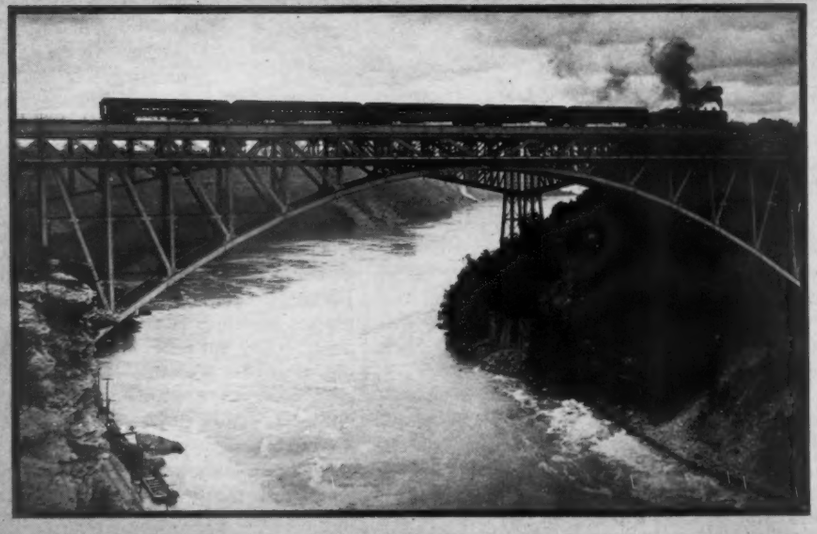
The use of acid-resisting nails to hold together a wooden flume required by the Phelps Dodge Corporation in one of its Arizona copper workings is not only saving the company money but relieving it of what was nothing short of a nuisance. Heretofore, ordinary steel nails were employed for the purpose; but as the water carried by the flume contains a relatively high percentage of acid, the nails corroded quickly and had to be replaced frequently to the detriment of the flume. The new nails are made of a 12 to 16 per cent chromium-iron alloy; and after many months of service are showing no signs of deterioration.







# Caravans &

WE picture here a few of the many modes of transportation that move the world's goods. Across the top of the page, a safari of East Africans is bearing merchandise from Uganda to Sudan. Breaking into the line is one of the most modern developments in railroading — an Ingersoll-Rand oil-electric locomotive pulling a freight train in Philadelphia.

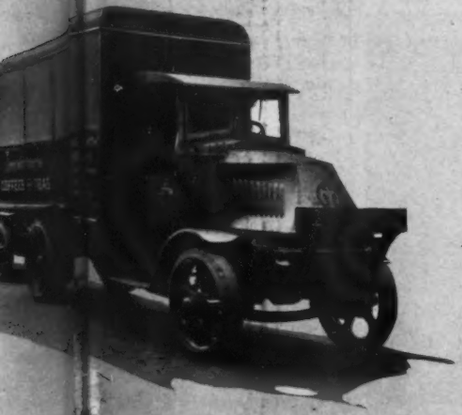
At the left, a camel caravan follows a

## ns of Commerce

winding trail in Palestine, while below it a passenger train crosses the gorge of the Niagara River on an arch of steel.

On the right are Chinese gardeners en route to a market thirty miles away, and underneath them a stub train pauses on Viscas Bridge in the Andes, 15,100 feet in elevation.

Below, in the center, is a truck cavalcade in New York City.



Ewing Galloway, New York

## PEOPLE CAN LIVE IN GLASS HOUSES AND THROW STONES

GLASS houses that are shatterproof may soon be a reality in the United States. As a matter of fact, a small house of this description has been built and is creating considerable interest. It is constructed throughout of a glass brick made of silica sand and developed by the Owens-Illinois Glass Company.

The new brick, we are told, has great possibilities as well as advertising value because it is translucent and can be given any coloring, either solid or variegated. Stores or shops of a certain kind built of glass brick would be sure to attract attention, during the day by reason of their pleasing appearance and after dark on account of the light shining through their walls. Conversely, the brick would let in daylight, and it has therefore been suggested as a roofing material and for constructing the upper walls of buildings. Oil companies are said to be considering its use for filling stations.

**Waterproofing the inside walls of the new wing of the Royal Ontario Museum with Ferrotite applied by the air-spray method.**

## FERROUS WATERPROOFING APPLIED TO WALLS BY AIR SPRAY

A DEVELOPMENT in waterproofing masonry walls with a ferrous solution is reported from Canada, where the mixture has been successfully applied by air spray instead of by brush and trowel, as was previously the practice. The practicability of the spray system was demonstrated first in the case of the new wing of the Royal Ontario Museum, in Toronto. Substantially 80,000 square feet of the inside wall surfaces of that addition were so coated in order to keep out moisture. As a result, the contract for the North American Life head office, to be built in the same city, specifies that the exterior walls be thus treated to protect them against the weather, while all Canadian Bell Telephone Company structures—that is, the parts that extend below grade, are to be similarly waterproofed. The engineering department of the Canadian National Railways is now putting the means and method to test with a view to using it in subways.

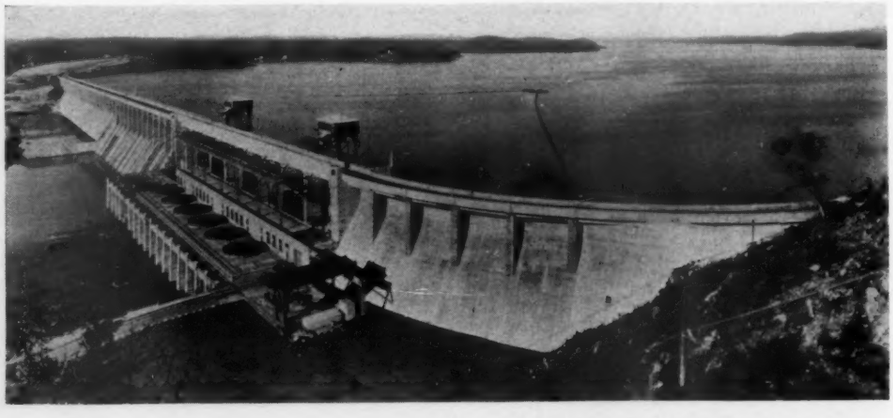
The Ferrotite formula calls for a mixture of powdered iron, an accelerator, and water, together with a small amount of cement—the effectiveness of the solution being mainly attributable to the fact that the minute particles of iron, upon oxidation, are increased to four times their normal size. The effect of this expansion is to key the waterproofing to the concrete and to fill the pores and air spaces.

Since the Ferrotite was first introduced, the Sternson Structural Specialties, Ltd., have been able to overcome the difficulty that originally prevented them from applying the mixture under pressure. Their problem was to keep the iron in the fluid in suspension. This they have solved by agitating the solution with air and paddles while the work is in progress. The spray method of waterproofing, according to G. Milson, engineer in charge of the museum job, has reduced labor costs and assures an even film, while the air, at 90 pounds pressure, drives the mixture into the pores and makes for a firm bond. Upon drying, the wall surfaces appear to be of a solid metal oxide. Approximately 1,000 square feet can be covered by this improved method in one hour.

## HYDRO-ELECTRIC PLANT EMBODIES NEW FEATURES

THE new hydro-electric development at Bagnell, Mo., on the Osage River, which is sending current over three transmission lines to St. Louis more than 130 miles away, is characterized by a number of interesting structural and engineering features. The most striking of these is the absence of the accustomed high-ceilinged generator room. Instead, the plant's six machines, each rated at 24,000 kv-a., are housed in an exceptionally low room, in the roof of which and in line with the generators are as many large round hatches sealed with heavy covers. Through these hatches the water-wheel runners were lowered for installation and can be withdrawn, if necessary, by means of a gantry crane traveling the length of the roof. For ordinary repairs, a rotor can be lifted clear of its stator without exposing the entire machine to the light of day. For this purpose there is an opening in each cover just large enough to receive the crane hook.

On a level with the hatches and parallel to the dam is a long narrow structure in which are the switchboard, switches, and associate facilities; and directly above this room and set back in a recess in the dam are the transformers. Of the three transmission lines one is of wood throughout, while the other two are a combination of steel and wood—the towers being of steel and the crossarms of wood. Wood, in this case, is of value as an insulator, and offers a maximum of protection against lightning. This is said to be the first example of this much-discussed construction, which was decided upon only after lightning tests of a full-sized transmission-tower top had been made at the Trafford high-voltage laboratories. The crossarms are hinged to permit a measure of horizontal movement.



Courtesy Westinghouse Electric & Manufacturing Co.

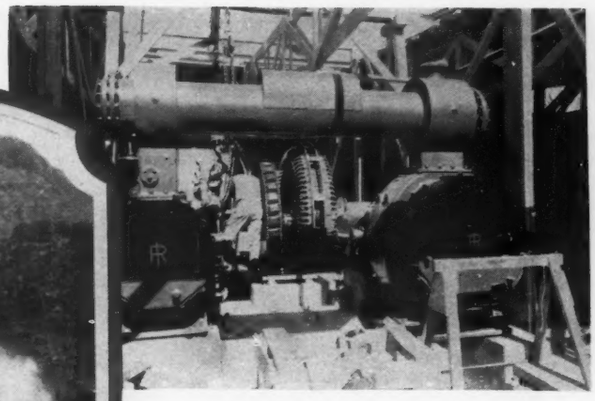
**Dam of the Union Electric Light & Power Company across the Osage River, showing the generator room with its hatches and the gantry crane in the foreground.**

## ARTIFICIAL MARBLE

MAGNESITE and stone dust are the basic materials used by a German to produce an artificial marble that in color and texture is said to resemble closely the marble of nature's making. The process has been patented recently, and consists of placing in a container layers of variously colored mortar and of pouring the mass on to the upper end of a slightly inclined glass plate.

The finely ground magnesite and stone dust are mixed dry and divided into as many piles as there are to be colors. After the pigments have been added, the piles, in turn, are converted into a thick paste by the admixture of a solution of alum-magnesium chloride; pressed through a screen; and put one on top of the other in the vessel ready for casting. The process of pouring the contents on to the glass causes the several layers to intermingle, forming what are described as very natural-looking veins and streakings. The cast slab on its base is stored for three days in a room kept at a constant temperature of approximately 61° F. When set, the slab of artificial marble is separated from the glass plate and finished by polishing.

Laying an air line across the Colorado River on a suspension foot bridge.



Erecting a Class PRE compressor—one of five such machines on the job.

# Construction of the Hoover Dam

## *Compressed Air Plays a Part of Vital Importance in this Huge Undertaking**

COPELAND LAKE

THE gigantic engineering and construction drama being enacted within the sheer walls of Black Canyon calls for many players, both human and mechanical. Various tools and machines of diverse sorts have already assumed important roles, and many others will attain prominence as the spectacle moves along toward its finale. No one of them, or no dozen of them for that matter, can, however, be given sole credit for the remarkable progress being made. All are important, not of themselves, but in conjunction with the others. Teamwork is paramount, but each contributor to the unison of effort that gets things done is as vital to the general scheme of operations as the strength of each individual link is to the power of a chain.

Keeping these things in mind, it is still possible to truthfully say that the rock drill, more than any other one class of tool or machine, has been the principal performer during the early stages of the work. It came into play at the very outset, and has been continually in the forefront of things ever since. Thousands of cubic yards of rock had to be removed by drilling and blasting in carving out the highways and railroad lines required to reach the canyon proper in order that work might begin in earnest. Long before these avenues of approach were in service, however, the advance guard of dam builders had floated down the river itself and established a meager foothold from which to start the first diversion tunnel adit, as was related in our May issue. Soon afterwards the first of the scores of "scalers" with their "Jackhamers" took up precarious perches at various points along the canyon walls to clear away loose and projecting rocks and to open up tunnel portals and other excavations. Then came the actual drilling of the 56-foot diversion bores. Meanwhile, a great amount of miscellaneous drilling was going on, so that literally hundreds of drills were in use virtually all the time during the first year after Six Companies Incorporated took active hold. At one time as many as 1,200 men were engaged in operations having to do with drilling, blasting, and moving muck.

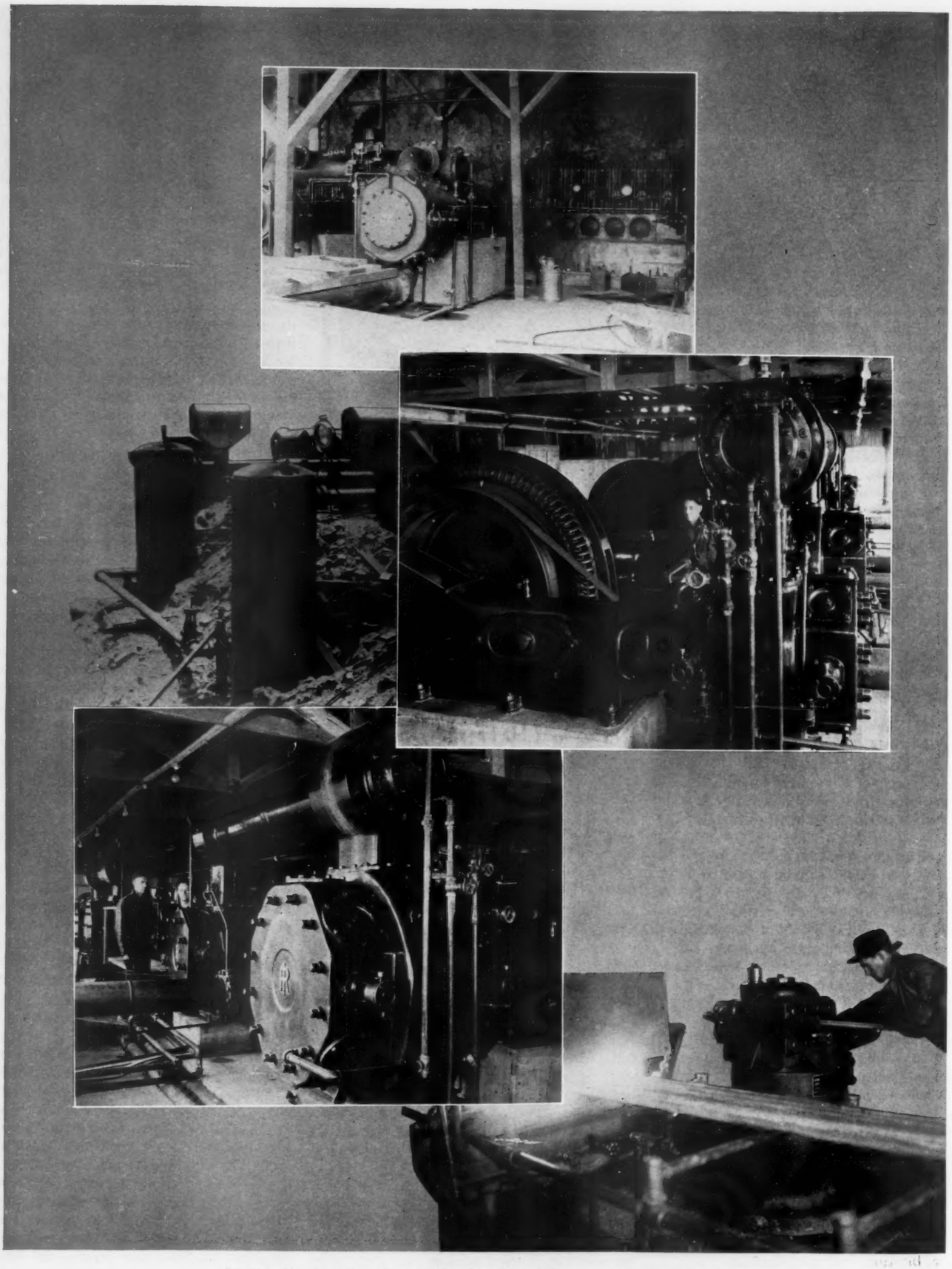
Since compressed air is the breath of life to the rock drill, it naturally follows that a compressor installation of considerable size was required. When the matter of such equipment was first taken under consideration it was estimated that approximately 25,000 cubic feet of air per minute would be needed, and plants aggregating that capacity were contemplated. Actually, however, the heaviest drilling schedule to be encountered during the life of the contract was carried out with a total air supply of 16,195 cubic feet per minute.

Because so much depended upon an adequate and sustained volume of compressed air during the initial stages of the work, Six Companies Incorporated weighed carefully the selection of the machines that were to be called upon to keep the program of rock drilling moving at a fast pace 24 hours a day with scarcely a break. In the course of the consideration it was decided that it would be advantageous to buy all the equipment required from one manufacturer so as to reduce negotiations to a minimum, to centralize the responsibility for installation and functioning of the compressors, to keep the necessary stock of spare parts low, and to simplify the duties of operation, care, and maintenance. It was also determined that it would be desirable to standardize, as far as possible, with respect to types or models and sizes. By so doing, spare parts would be largely interchangeable among the various units, and the problems of operation, care, and maintenance would become proportionately simpler.

Obviously, the primary demand was for compressors that would perform efficiently and that would, moreover, stand up under the rigorous service conditions that were bound to be imposed upon them. With a view to making a choice that would satisfy these vital demands, those charged with the responsibility of purchasing the air equipment gave close attention to the past records of the various makes of compressors which were being offered them.

In addition to the foregoing factors there was, however, another point which had to be taken into account in connection with the plans for the air plant. This had to do with the scheme which had been devised for cooling the concrete in the great dam which will some day stay the rush of the Colorado River. As is well known, the chemical processes which take place during the setting of concrete are accompanied by the generation of much heat. This heat has the effect of expanding the mass, which calls forth the reciprocal action of contraction when the heat is given up. When large blocks of concrete are poured at a time, this inevitable contraction produces fractures which weaken the structure. To obviate these difficulties, it is the universal practice to rear concrete dams on a sort of stagger system—that is, to build them progressively in sections or columns which are carried upward by easy stages. Adjacent columns are poured at different intervals, and the intervening spaces are left open for sufficient periods to facilitate the cooling of the concrete by providing radiating

*Eighth of a series of articles on the Colorado River and the building of Hoover Dam.



**At the top is one of the diesel-engine-driven compressors used until electric power became available. Next below it and at the left are two Annis filters on the air intakes of compressors. At the right, and also below, are views in Compressor Plant No. 3. At the bottom are a No.26 oil furnace and a No. 50 drill-steel sharpener in action.**

surfaces exposed to the air on all four sides. In effect, the whole area to be concreted is checkerboarded, and the squares are built up a little at a time with no two squares having sides in common being poured simultaneously. Such a system insures a minimum of shrinkage and compensates for such contraction as does take place by setting up joints which can afterwards be sealed tight with grout.

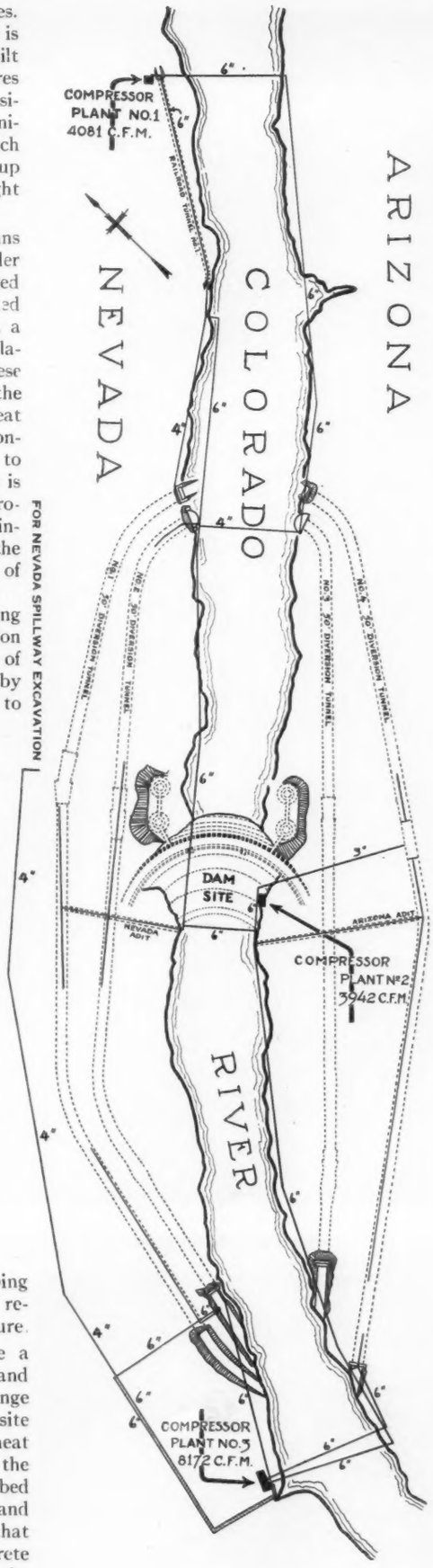
As the gaps between alternating columns in the same horizontal plane cannot, under customary methods of procedure, be poured until the major portion of their contained heat has been dissipated, the progress on a dam as a whole is necessarily slow. On relatively small structures the sum total of these delays is not of much consequence, but in the case of the Hoover Dam, with its great monolith of 3,400,000 cubic yards of concrete, it would, in the aggregate, amount to a tremendous period of time (the estimate is 200 years and more) and have the result of prolonging the construction, correspondingly increasing the expense, and postponing the date when the structure would become of service and value.

Accordingly, in the interest of quickening natural processes, the Bureau of Reclamation engineers specified that artificial cooling of the concrete should be brought into play by the contractors. It is not our purpose to here describe how the dam will be assembled, but rather to sketch the essential features of the projected plan for cooling the concrete because of the bearing it had on the selection of the air-compressing equipment.

The specifications require that after any portion of the concrete in the dam (and tunnel plugs) has set for a minimum period of six days it shall be cooled by removing the excess heat above 72° F. This is to be done by circulating water of requisite coolness through the concrete by means of a system of pipes. This involves the provision and operation, by the contractor, of a complete refrigerating plant.

To carry out this scheme, there will be needed a network of 2-inch piping aggregating 800,000 linear feet, or roughly 150 miles. This will be assembled in the form of loops or series of loops ranging up to a maximum length of 1,600 feet. Where pipes cross contraction joints they will be linked by expansion-type couplings. This piping will be embedded in the concrete and will remain a permanent part of the dam structure.

When poured, the concrete will have a temperature somewhere between 40° and 100° F. Because of the wide seasonal range in the natural temperature at the dam site —from 25° to 125° F.—the amount of heat that will have to be extracted to lower the temperature of the concrete to the prescribed 72° will vary greatly as between summer and winter. The average temperature rise that will result from the setting of the concrete will be 40° above that at which it will be placed. The amount of heat that will have to be removed is about 700 B.T.U's per degree per cubic yard of concrete. The estimated quantity of heat to be extracted from each cubic yard of concrete during each month of the year, and the time that will be required to do this, are shown in a table, on a following page, which is from specifications prepared by the Bureau of Reclamation. It is to be noted that the actual amounts may vary considerably from the estimates in any one year, as the figures are based on average natural temperatures.




**The compressor plants and principal air delivery lines.**

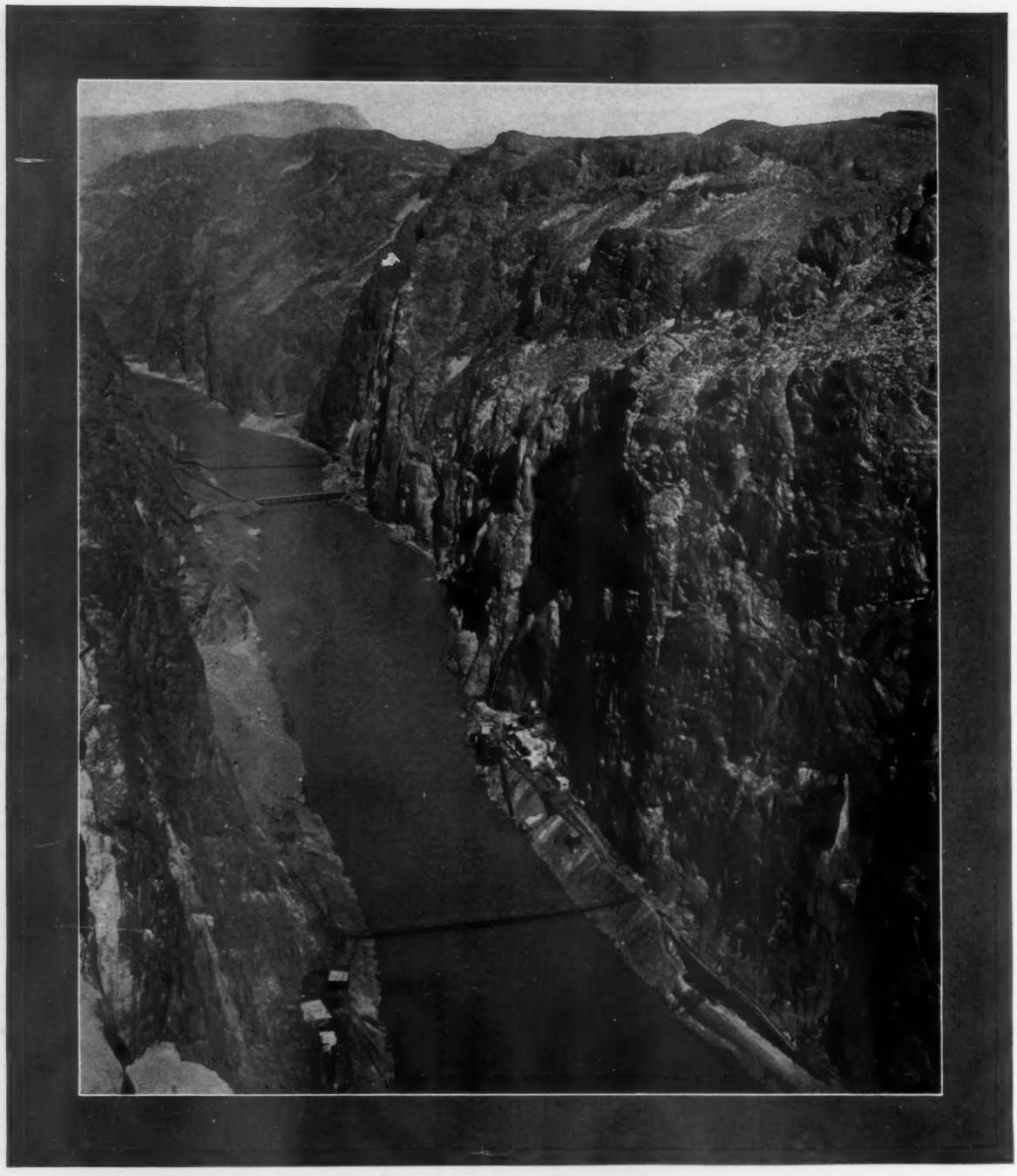
It is provided that the refrigerating plant shall have a capacity sufficient to reduce from 47° to 40° the temperature of a flow of water of 2,100 gallons per minute. The water entering the cooling pipes shall not have a temperature lower than 35°, and may leave the embedded pipes at any temperature between 42° and 65°. The quantity of cooling water circulated may vary from 350 to 2,100 gallons per minute.

It can be realized from the foregoing facts that the contractors had in mind something besides the provision of an adequate air supply when they considered the purchase of compressors. They were concerned with obtaining machines which would not only prove efficient, reliable, and economical as air producers but which could also be readily converted, as needed, into refrigerating units.

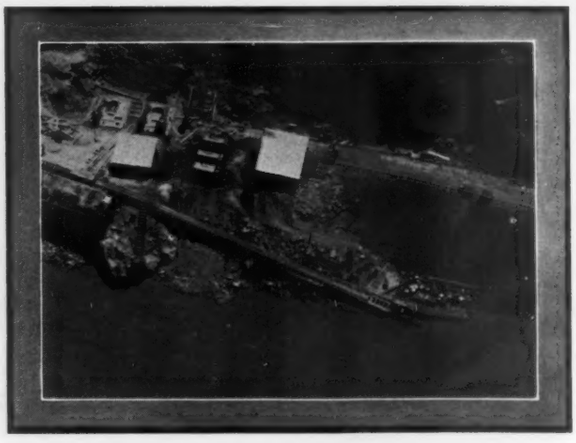
After due investigation, they selected Ingersoll-Rand electric-driven compressors equipped with clearance-valve control. In all, eleven machines were purchased. Five of them are Class PRE-2 units, each of 26&16¼x18-inch size and having a piston displacement of 2,195 cubic feet per minute. The six others are the similar although smaller Type XRE-2 machines, each 20&12½x14 and with a piston displacement of 1,302 cubic feet per minute. All are driven by Westinghouse synchronous motors with belted exciters. When the time arrives to set up the cooling plant, the substitution of ammonia cylinders for the regular cylinders on a suitable number of these compressors will convert them into efficient refrigerating units. It is expected that only the XRE machines will be used for this purpose, and that not all of them will be required.

To supply air on the job, there were established three compressor plants, the locations of which are shown on the accompanying map, together with the principal air delivery lines. It will be noticed that although the plants were not close together—the extreme distance being some two miles between Plants Nos. 1 and 3—all were connected by the piping system.

As told in our May issue, Plant No. 1, at the upper end of the canyon, was the first installed. Until electric power became available in the early summer of 1931, the two Type XRE units which it then contained were operated as belted machines with power furnished by two Atlas diesel engines. Plant No. 2, near the adit leading into the diversion tunnels on the Arizona side of the river, was the second to be set up, and it consisted of two Class PRE machines. Plant No. 3, just below the lower portals of the Nevada diversion tunnels, was the last to be erected, but became the largest of the three, with a



**Above is Black Canyon as viewed from the top of the Nevada cliff and downstream from the dam site. The benches at the river edges were built up of muck taken from the adits and the diversion tunnels. The dam will rise at about the line where the lowest bridge spans the Colorado.**



**Left—Compressor Plant No. 2 as it appeared from above during erection. In the upper left-hand corner can be seen both frames of one machine and one frame of another one. Below them and at the right are three portable compressors. This plant is at the right of the river in the picture above.**

capacity of approximately 8,172 cubic feet per minute. Plant No. 2 had a capacity of 3,942 cubic feet per minute. Plant No. 1 had an initial capacity of 2,210 cubic feet per minute, which was later increased to 4,081 cubic feet per minute through the addition of a Class PRE machine.

With the exception of the two Type XRE machines in Plant No. 1, all the compressors were served by I-R Class HM tubular-type aftercoolers. These coolers added to the efficiency of the drills by eliminating troubles arising from moisture in the air lines. To further guard against preventable troubles in the air system, the compressor intakes were equipped with Annis air filters of the type which can be cleaned with an air blast without taking them out of service. Circulating water for the compressors was supplied by Cameron Motorpumps, which combine a motor and a centrifugal pump in one compact casing. Two such pumps were installed in each plant.

Since the several installations were of a temporary nature, and as the chief concern of the contractors was to get the compressors operating, no effort was made to erect model plants from the standpoint of appearance. The machines were set up in the open, and rough buildings were later constructed around them. The piping was chosen on the basis of sizes available rather than of which were preferable to make a neat-looking job. Six Companies Incorporated asked only that the machines function properly and keep the drills pounding away at the rock; and the record of the drilling accomplishments shows that they were given no cause for disappointment on this score. The air was discharged from the compressors at 105 pounds pressure, and was delivered to points of work on the spillways as much as a mile away at 80 to 85 pounds. Within the tunnels the pressure seldom was below 90 pounds.

*Snaking a portable up a steep slope.*

Most of the compressors were installed during the torrid season of 1931, at a time when it was impossible to handle metal in the sun with the bare hands. On more than one occasion gasoline, which was being used to clean small parts, caught fire through spontaneous combustion. The first two machines to be set up were floated down the river on barges. Rock had to be blasted away at the foot of a cliff to secure enough level space to erect them; and they were snaked up the steep slope from the river with block and tackle. Plant No. 2 occupied ground reclaimed from the river by filling in at the base of the cliff with spoils from the first of the adits, which was started with air from portable compressors. The units installed there also were floated down the river.

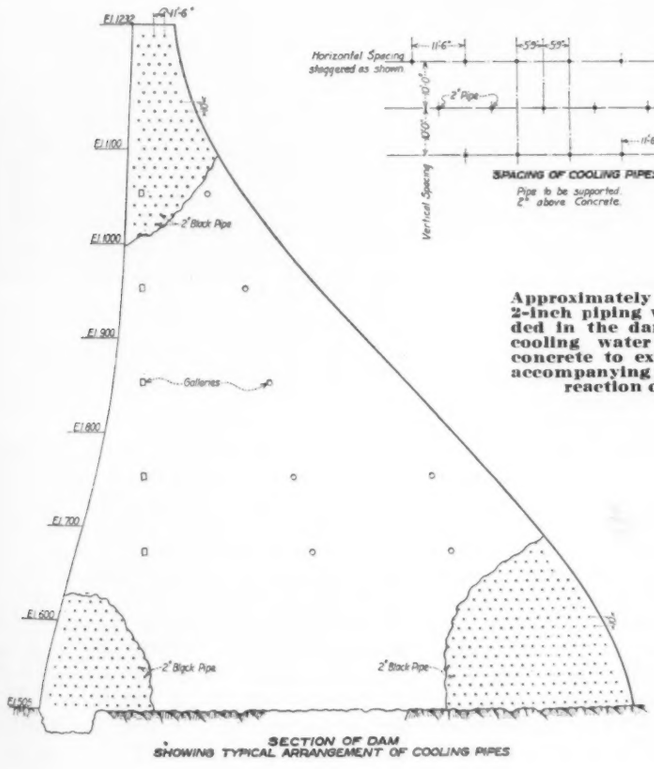
During the period of approximately a year that they furnished air for the tunnel drilling, the compressors were called upon to operate through a temperature range from around 125° in July to as low as 14° during the winter. Throughout virtually all this time they ran 24 hours a day and seven days a week, and remained in service weeks at a stretch without shutting down. No repairs were required and the valves were cleaned only once. This is considered a remarkable record for compressors operating under such climatic conditions.

In the foregoing narrative, and in the last previous installment in this series of articles, we stressed the part that rock drills have played and will continue to play during what might be termed the preparatory stage of operations. While it is true that drilling constitutes the major use of compressed air, there are so many other ways in which this medium of power transmission is being employed that our present account should at least mention them if it is truly to portray the importance of compressed air in connection with this epoch-making enterprise. As future articles will deal with some of these functions more in detail, it is our present purpose merely to set them down for the sake of completing the record of the principal services of pneumatic power.

Seldom, if ever, has one contracting job afforded so many or such diverse applications of compressed air. An unofficial but prob-

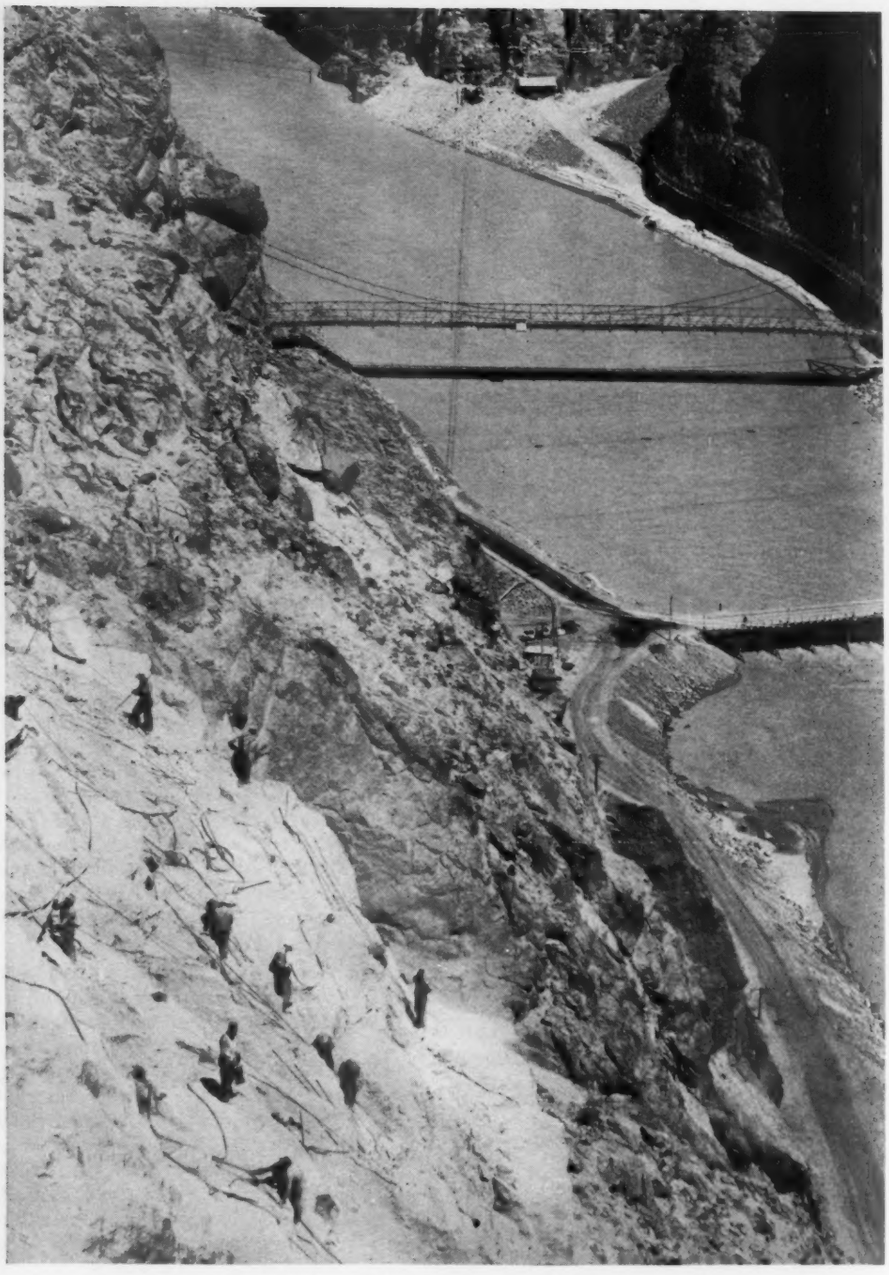
HEAT UNITS TO BE EXTRACTED FROM CONCRETE TO ACCELERATE SETTING

| | Mean Monthly Temperature | Maximum Temperature of Concrete | Heat to be Extracted | B.T.U's to be Extracted Per Cu. Yd. | Cooling Water Must Be Applied |
|---|---|---|---|---|---|
| | *Fahrenheit* | *Fahrenheit* | *Fahrenheit* | | *Months* |
| January | 52.0° | 92.0° | 20.3° | 14,200 | 1.14 |
| February | 57.2° | 97.2° | 25.5° | 17,900 | 1.33 |
| March | 63.6° | 103.6° | 31.9° | 22,400 | 1.60 |
| April | 71.2° | 111.2° | 39.5° | 27,700 | 1.83 |
| May | 78.6° | 118.6° | 46.9° | 32,900 | 2.06 |
| June | 87.6° | 127.6° | 55.9° | 39,200 | 2.28 |
| July | 93.8° | 133.8° | 62.1° | 43,500 | 2.40 |
| August | 91.9° | 131.9° | 60.2° | 42,200 | 2.37 |
| September | 83.0° | 123.0° | 51.3° | 35,900 | 2.17 |
| October | 70.8° | 110.8° | 39.1° | 27,400 | 1.83 |
| November | 59.4° | 99.4° | 27.7° | 19,400 | 1.39 |
| December | 51.5° | 91.5° | 19.8° | 13,900 | 1.10 |
| Average | 71.7° | 111.7° | 40.0° | 28,000 | 1.79 |




**Approximately 150 miles of 2-inch piping will be embedded in the dam to circulate cooling water through the concrete to extract the heat accompanying the chemical reaction of setting.**

SECTION OF DAM
SHOWING TYPICAL ARRANGEMENT OF COOLING PIPES



**"Jackhamer" men clearing the area where the 50-foot spillway tunnel on the Nevada side will have its opening. This inclined waterway is being driven by raising from the diversion tunnel with which it will connect.**

ably quite accurate count reveals that there are approximately 500 individual tools or machines which are driven by air. The list is growing all the while, and many additional uses will no doubt be found before the contract is completed.

Besides the great number of "Jackhamers" and drifter-type drills which have been mentioned, there are about 25 stoper drills in service. These are Ingersoll-Rand CCW-11 and R-51 types, and are used principally in raising from the diversion tunnels on either side of the river the inclined shafts which will serve as spillways to take care of excess water in the dam without the necessity of running it over the top of the structure.

There are 25 Ingersoll-Rand Type CC-45 paving breakers and ten air-operated hoists at work. Both of these classes of machines perform a miscellany of services. Smaller pneumatic tools abound, among them being twelve clay diggers and varying numbers of drills, riveting hammers, chipping hammers, grinders, etc. All are of Ingersoll-Rand manufacture.

Much air is, of course, consumed by the sharpeners, oil furnaces, shank and bit punches, and pedestal grinders required in connection with the reconditioning of the vast amount of drill steel and paving-breaker steel on the job. At the peak of the drilling operations, there were as many as ten completely outfitted blacksmith shops for the performance of these services. The equipment in each shop included a No. 50 drill-steel sharpener, a No. 26 oil furnace, a No. 8 pedestal grinder, and a No. 6 drill for drilling out plugged steels. Approximately 3,500 pieces of steel were reconditioned every 24 hours during January 1932, when the work in the tunnels was being pushed at top speed. These blacksmith shops were moved about from time to time as the drilling progressed. Not all of them are in use now that the heavy drilling schedule has been completed.

Cameron pumps of several types and sizes are used at various points for the handling of water. Many of these are pneumatically operated. Air-driven Fuller-Kinyon pumps are employed to convey bulk cement from the box cars in which it is delivered to the top of the concrete mixing plant. Gates on the batchers, mixer hopper, and dump hopper in this plant are controlled by compressed air. Before placing the concrete lining in the invert of the diversion tunnels, it is necessary to scour the rock surfaces free of all dirt and pebbles. This is accomplished by means of compressed air used in conjunction with water.

All in all, there seems to be plenty of justification for the statement that compressed air is in the forefront of the indispensable agencies at Hoover Dam.

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## PRODUCTION OF TUNG OIL IN THE UNITED STATES

EXPERIMENTS with the cultivation of the tung tree in the South have reached a stage where it is safe to predict the establishment there of a new industry that will help to solve a problem that has been confronting the owners of cut-over lands in that part of the country. It has been found that the tung tree can be grown successfully in a large zone, normally immune to frost, which extends from the southern border of Georgia to the south-central section of Florida, and thence westward along the gulf coast of Florida, Alabama, Mississippi and Louisiana.

The tung tree is indigenous to China, and yields an oil that is an important ingredient in quick-drying varnishes. This is its principal use; but it is also required in making insulating compounds, automobile brake linings, gaskets for steam pipes, and linoleum, for waterproofing fabrics and paper, as a binder for wall board and plastic synthetic lumber, etc., etc. For these purposes it has been necessary to import annually tung oil to the value of approximately $12,000,000, and all of this has come from China.

Attempts to make ourselves independent of this source of supply began back in 1905, when it became increasingly difficult to refine the oil that was being adulterated with varying quantities of soy-bean oil. In that year, David Fairchild, plant explorer of the Department of Agriculture, brought the first seeds to the United States from the Yangtse Valley. Since then, 20,000 acres have been set out in tung trees; and it has been roughly estimated that it would take from 50,000 to 100,000 acres, with 100 trees to the acre, to provide us with all the oil we need.

Scenically beautiful Water Gap near Clifton Forge, Va. Photos, Courtesy Chesapeake & Ohio Railway

# Chesapeake and Ohio Railway Making Ready for Bigger Business

**PART I**

**R. G. SKERRETT**

PROSPERING railroads have been few and far between in this country of late. The Chesapeake & Ohio Railway, happily, is an exception to the rule in this respect, and one may reasonably ask: What has placed the system in so favorable an economic position?

The Chesapeake & Ohio is one of the nation's leading carriers of bituminous coal; and something like 81 per cent of its freight service is absorbed in the transportation of that fuel. The system taps the vast coal area of West Virginia, in which the cost of production is notably low; and this state of affairs, combined with physical conditions, makes it possible to move the coal expeditiously, efficiently, and at moderate outlay to tidewater and to other markets.

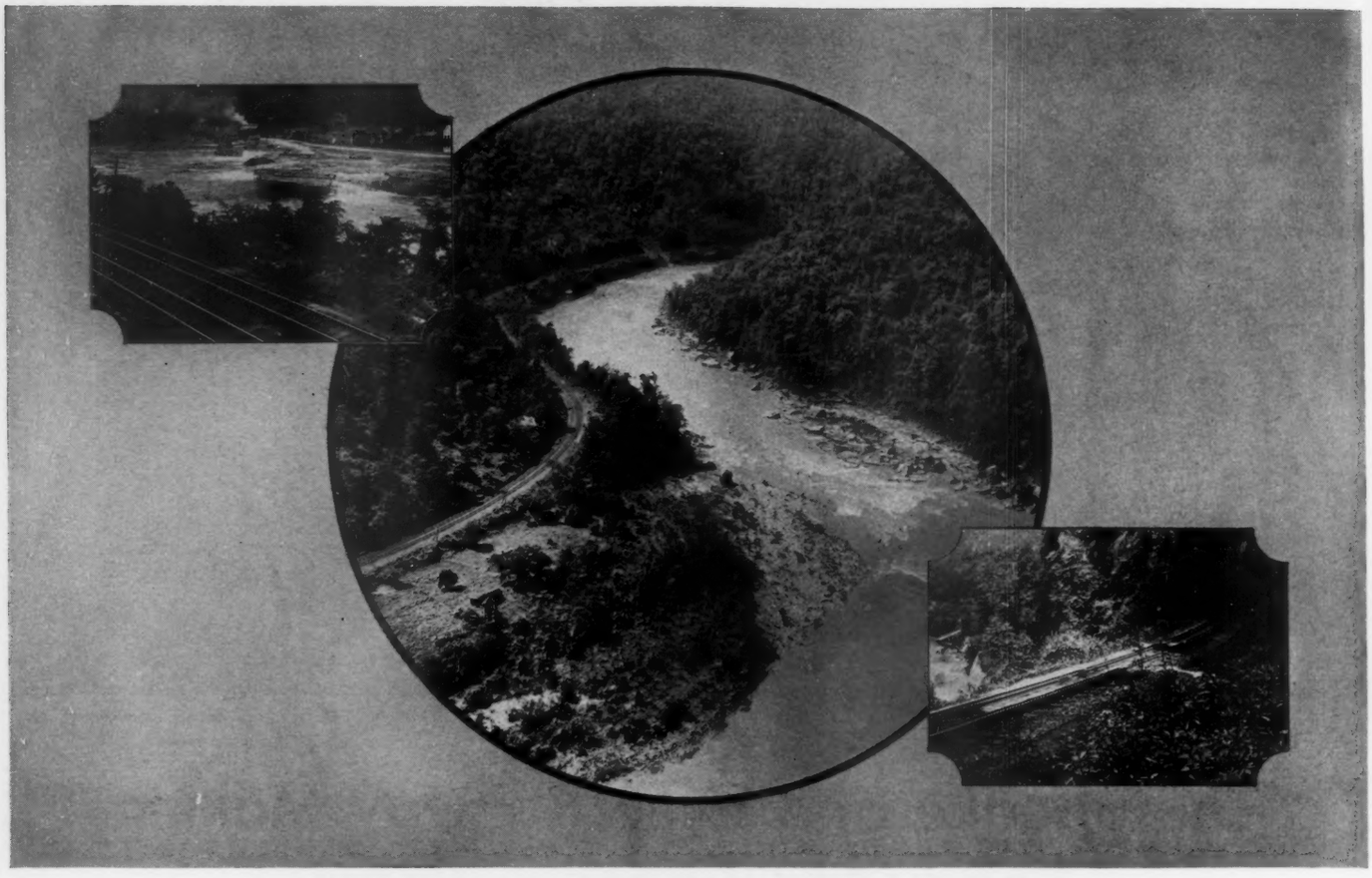
How the Chesapeake & Ohio's coal business has developed is indicated by some contrasting figures. In 1921 the road produced 25,516,715 tons of coal and coke: in 1929, 58,649,285 tons. Of that volume no less than 47,548,000 tons originated within the West Virginia area traversed by the line and numerous of its tributary branches. This coal business may not improperly be described as the line's dependable revenue-making "backlog" that has held up remarkably well as a source of income despite the long period of general depression.

In 1921 the operating expenses totaled $66,603,077; and in 1929 they aggregated $85,514,858. Even though the expenses in that interval increased only 28.4 per cent, still the revenue freight during that span had gained 75.2 per cent in tonnage! The cost of carrying freight had been decreased through gains in efficiency, and there was an accompanying reduction in operating costs. These splendid results are the consequence of skillful management and widespread improvements—the latter being part of a program of betterment that is still actively in progress.

Back in 1923 the Chesapeake & Ohio Railway initiated a comprehensive scheme of improvements—the work to be spread over a period of years. This program has been explained as follows by Mr. R. N. Begien, vice-president of the system: "Additional facilities and improvements in maintenance of way and maintenance of equipment were planned and budgeted, to be provided as the growth of traffic and operating conditions required them." Competition encouraged among the various maintenance-of-way forces was effective in raising the standard in that department of the organization and, as an outcome, the cost of freight-train expenses—including locomotive and car repairs, of moving 1,000 gross ton-miles, for example, was reduced from $1.25 in 1923 to $0.75 in 1929, representing a saving of 40 per cent. By changing grades and easing curves it was possible to obtain more dependable train movements, to make faster time, and to lower the operating costs.

Mr. Begien has given other illuminating figures that show what advances have been made in the directions of amplified service and diminished outlays. For instance, the car-miles per day per car in 1923 amounted to 34.7; in 1928, to 52.7; and in 1929 to 54.8—the betterment for 1929, compared with 1923, being 57.9 per cent. The gross tonnage per train, not counting locomotive and tender, was 2,302 in 1923; 2,711 in 1928; and 2,833 tons in 1929—an increase in 1929 as against 1923 of 23.1 per cent. In 1923 the system as operated embraced 2,553 miles. Five years later it was made up of 2,724 miles, and in 1929 of 2,735 miles—an increment in 1929, compared with 1923, of 7.1 per cent. On the roadway owned and leased, the company operated 3,120 miles in 1930 and 3,115 miles in 1931.

Freight train-miles in 1923 totaled 10,934,471; in 1928 they numbered 13,278,416; and in 1929 the figure was 13,298,690—an increase, contrasting 1929 with 1923, of 21.6



**Circle—Where densely wooded hills border the New River. Top—Kanawha Falls, W. Va., where the New River ends and the Kanawha River begins. Bottom—Blue Hole Tunnel near Gauley, W. Va., before the relocation of the line.**

per cent. By augmenting the net ton-miles per diem from 860 in 1923 to 1,284 in 1928 and to 1,339 in 1929, the saving in car-days during 1929-1923 amounted to 8,416,223. In the same interval the Chesapeake & Ohio was able to reduce the expense of passenger trains per mile to the extent of 14.6 per cent. Many other data might be cited in evidence of the splendid strides the system has been making in recent years, but they would be only added proof of what farseeing and competent management has made possible.

Let us quote just one paragraph from an economic survey of the road that was made early in the past year:

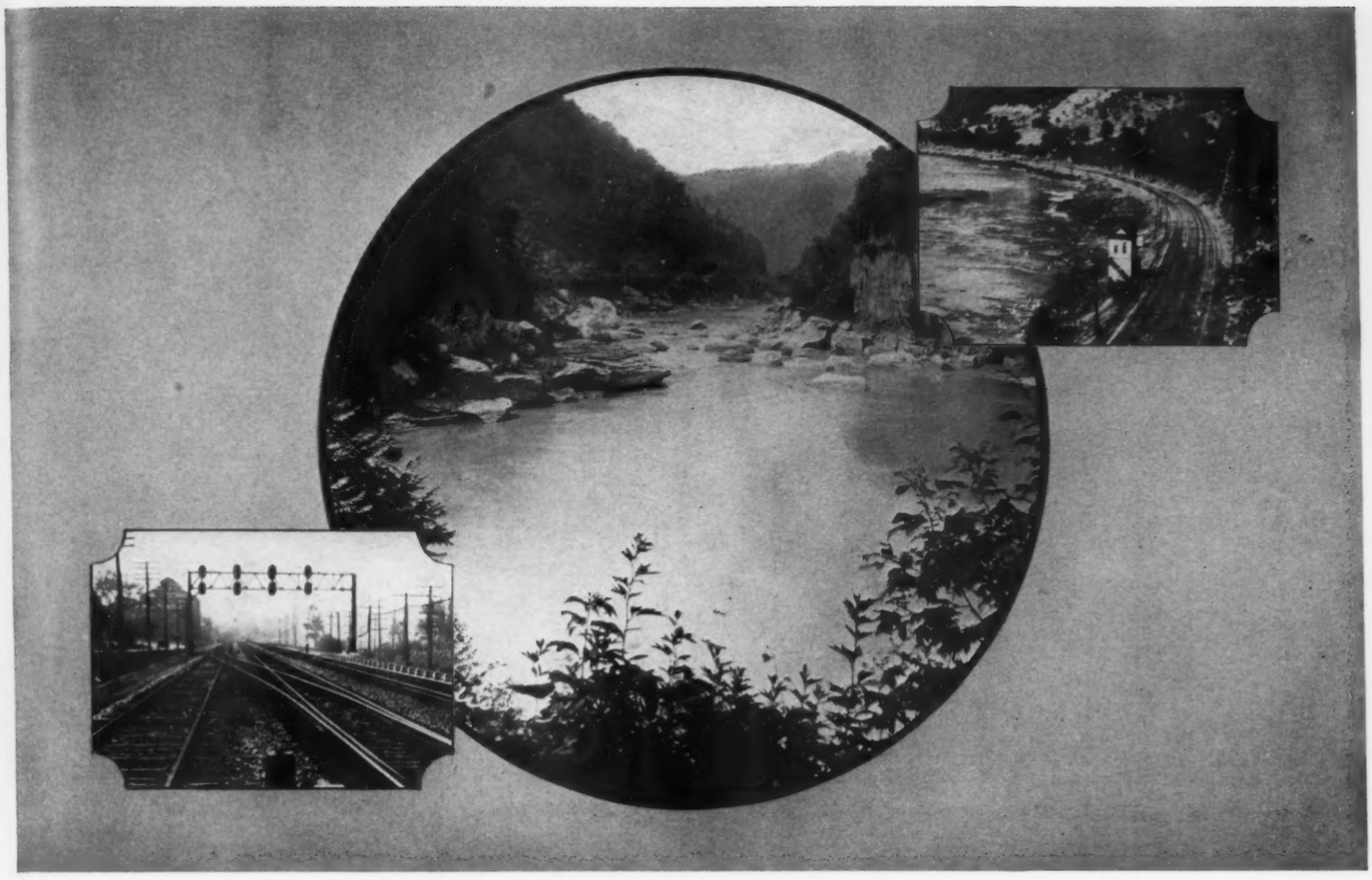
"In 1929, when all the competitive drawbacks were present, about which there has been so much adverse comment in the last year, Chesapeake & Ohio had one of the best years in its fifty-two-year history. It handled 69,766,980 tons of revenue freight, nearly the greatest traffic in its history, and broke all records for net earnings. This record was made despite the fact that passenger traffic declined and freight rates have been decreasing and wages increasing for a number of years."

The foregoing fiscal details tell only a part of the story of the railroad's latter-day development. The purpose of this article is primarily to describe certain improvements now in hand and which, when completed, will enable the Chesapeake & Ohio to perform its service more economically and to handle shipments of different kinds that have heretofore been prohibited because of restricted clearances in a number of tunnels that were built a good many years ago. The refusal of such shipments has denied the railway revenue aggregating millions of dollars.

In the work that is now underway some tunnels are being enlarged so as to permit double-tracking with standard clearances. In other cases new paralleling tunnels are being constructed; and, finally, open cuts are taking the places of long-used tunnels—thus obviating outlays for upkeep. Curves and grades are undergoing revisions wherever those changes can be made to advantage. Increased clearances, apart from allowing the handling of some bulky shipments, will permit the use of larger and more powerful locomotives which can be counted upon to contribute to operating gains and economies. Some of the tunnels that are being abandoned or enlarged were driven when rock-drilling was generally done by hand; and several of them were completed only after years of laborious work in piercing the interposed rock formations. Some knowledge of the history of the Chesapeake & Ohio system will help to a better understanding of the projects in hand.

The Chesapeake & Ohio Railway is largely the outgrowth of the Louisa Railroad Company which was chartered by the State of Virginia in February of 1836. That pioneer line became the Virginia Central Railroad Company in 1850—the expanded system being extended later so as to link Richmond, Va., and Covington, Va. Covington is on Jackson River, near the present border line between Virginia and West Virginia. Covington was designated as the eastern terminus of a projected rail route, authorized by the State of Virginia in 1853, which was to connect that point with a contemplated terminus on the Ohio River in the neighborhood of the mouth of the Big Sandy River. West Virginia, at that time, was an integral part of the Old Dominion.

Comparatively little in the way of actual building was done on the projected Covington & Ohio Railroad prior to the outbreak of the Civil War; and before the close of that conflict West Virginia attained independent statehood. In 1867 the legislatures of Virginia and West Virginia authorized the consolidation of the Virginia Central Railroad



**Circle—Looking downstream on the New River toward Blue Hole Tunnel. Top—Where the Chesapeake & Ohio Railway follows the New River west of Hinton, W. Va. Bottom—Three-track section of the system on the Huntington Division.**

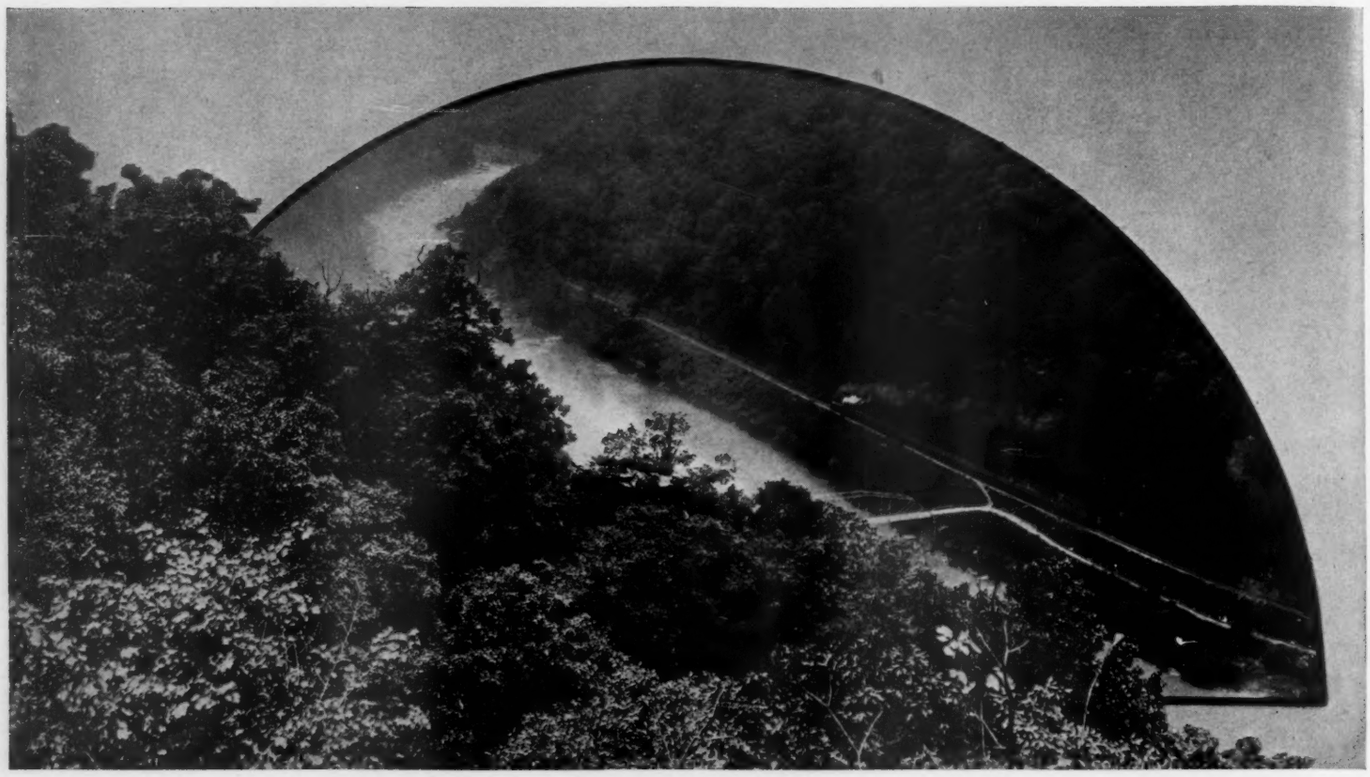
Company, an active going concern, and the Covington & Ohio Railroad Company which, for practical purposes, was not much more than a name. The combination became known as the Chesapeake & Ohio Railroad Company. Prior to the merger, the Virginia Central Railroad Company had agreed to run a railway from Covington, Va., to the Ohio River—in other words, to complete work that the Covington & Ohio Railroad had little more than started. Parts of the route west of Covington traversed the very heart of the Allegheny Mountains, and at points had to contend with extremely rugged and difficult country. This is strikingly evident where the Chesapeake & Ohio, today, parallels sections of the New River.

The New River is scenically one of the most beautiful streams in the eastern part of the United States, and is what it is because, in its career, it has been deflected by obtrusive mountains, turned at right angles from its primordial course, and forced to overcome stupendous obstacles in cutting an outlet for itself. In this quest for freedom of movement the New River carved a canyonlike passage that reaches a maximum depth of 1,500 feet below the plane upon which it made its way in the dim past. As the late James Poyntz Nelson wrote, "Thus it is that the New River, in making its canyon, has isolated itself from the rest of the world so that, before the building of the Chesapeake & Ohio Railroad, the New River went its way unknowing as to the outer world and unknown thereto until it plunged over what is known as the Kanawha Falls, the westward limit to the great conglomerate series, and became the Kanawha River."

The erosion which formed the path for the New River, and the recurrent uplifts that served only to intensify the velocity of the stream and its wearing action, promoted the formation of bare and austere cliffs that for untold time forbade access to the river from the flanking uplands. Repellent as were the results of the geological changes, still the net consequence was to carve the great natural highway now used by the Chesapeake & Ohio Railway for something like half a hundred miles. But much difficult engineering work had to be done before a way was clear for the trains that were to mean so much to the territory served by them. It was not until 1873 that the first of these trains threaded its way through the New River Canyon.

The engineers engaged in building that part of the line had their work repeatedly undone by heavy slides of earth and rock. These either buried the path cut for the railroad or upheaved it by reason of released pressures previously developed within the contiguous mountains. The mountainsides have been formed generally by slides of earth and rock brought to rest against tall cliffs; and the blasting necessary to the running of the right of way opened crevices between the cliffs and the incumbent material. Into these openings penetrated water from rain and melting snow, and induced heavy hydraulic pressures. As a consequence, excavating by the railroad builders led to an unbalancing of pent-up forces that brought about readjustment either through landslides or more or less momentous upheavals in the course of the advancing railway.

In addition to the foregoing setbacks with which the engineers had to battle continuously, there was also the problem of getting food, equipment, and structural supplies into the territory. For many miles no roads fit to be called such reached into the New River Canyon to facilitate the transportation of these essential materials. On numerous occasions, food, machinery, etc., had to be moved by hand over the mountains and down into the depths of the gorge. Undismayed by these handicaps, the men responsible for the



**Part of the New River Canyon in the neighborhood of Fayette, W. Va.**

construction of the Chesapeake & Ohio went ahead grimly determined to succeed.

One might say in all truth that the inception of the Chesapeake & Ohio Railway was the consequence of George Washington's urge that trade routes be opened between the Atlantic seaboard and the vast and potentially productive region contiguous to the Ohio River. His idea was that the pioneers of that hinterland should be linked with the seaboard colonies by reciprocal interests so that they would not become affiliated with the peoples of alien flags established in or near the Ohio Valley. The main stem of the Chesapeake & Ohio system adheres closely to the trails first trodden by the red man, and, later on, was broadened by the early white settlers who penetrated the depths of the Allegheny Mountains. Tradition has it that the Sandusky Indians used to travel south from Ohio on their annual hunt, and that it was their custom when doing so to leave their aged and infirm kin at White Sulphur Springs to be helped or cured of their ills. Subsequently, stage coaches, covering the journey between Virginia and the Ohio River, followed the same route. Remnants of some of the old roads bear silent testimony to the toilsome grades that had to be negotiated in those distant days.

The Chesapeake & Ohio has, like other railroads, had its ups and downs; but the spirit of the men who originally conceived the principal parts of the system has survived in those who have succeeded them. Courage, capability, and farsightedness have carried the road forward against all odds; and time and time again the skill and resourcefulness of the system's engineers have transformed hostile nature into a helpful servant. In the process of its growth, this great railway has absorbed contributive branch lines which, in many instances, lead to and from well-nigh inexhaustible deposits of coal—the loaded trains from pit mouths commonly following descending grades to markets, thus reducing the cost of hauling. The Chesapeake & Ohio has contributed greatly to the development of the regions traversed by it. It has provided an outlet to natural riches and to the products of farms and factories; and it has created new centers of industry and has brought revived energy to communities that had previously shown a tendency towards retrogression.

Year by year, for some time past, there has been a steady increase in the volume of business handled by this typically up-to-date and enterprising system. In order that it might efficiently take care of this augmenting business, the railway has been engaged in costly and substantial betterments of roadbed and other associate features of the line. Present interest in these endeavors is centered on a stretch of approximately 115 miles that extends westward from about twelve miles east of White Sulphur Springs to the vicinity of Gauley, W. Va., not far from where the New River empties into the Kanawha River. At thirteen points within this section, extensive tunnel work has been in hand for some while; and when these several contracts are finished the Chesapeake & Ohio Railway will be in a position to serve its passengers and its shippers better than ever before.

**Another view of the New River Canyon west of Nuttall, W. Va.**

The stretch of the main stem under consideration constitutes what might properly be termed the bottleneck of the system. It is interposed between Louisville, Cincinnati, Chicago, and Toledo to the north and west, and Richmond, Newport News, and Washington to the eastward. Manifestly, the work in hand will lead to a stimulated flow of traffic and contribute the while to both operating economies and larger returns. In the next installment of this article we shall deal separately with the tunneling operations that are to amplify the capacity of the road. There are many interesting aspects to these undertakings.

(*To be concluded*)

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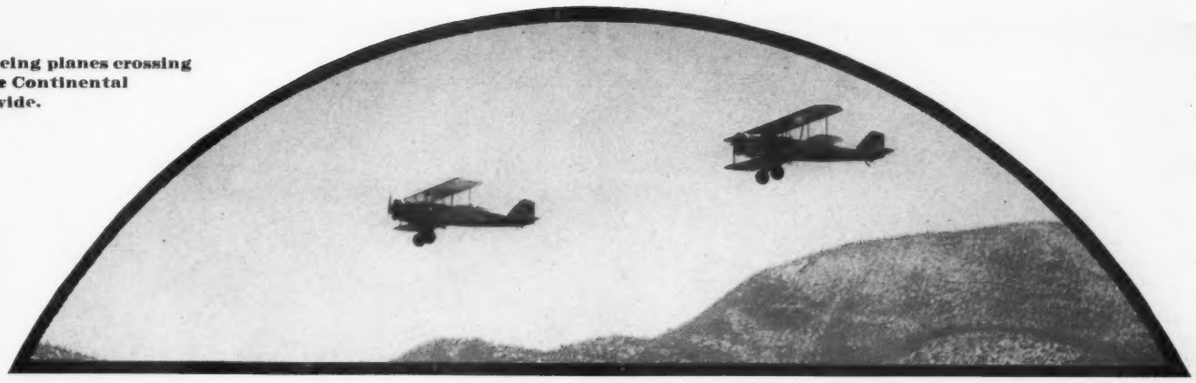
Glass has such innumerable uses that it is hard to conceive of a new one, and yet the industry has discovered that it is a suitable material for blackboards. For this purpose the glass is hardened by the addition of a mineral called black chromite, which gives it the necessary color and rough surface.



**Boeing planes crossing the Continental Divide.**

# Airplanes Retrace Historic Western Paths

**A Fokker looks down upon Butte's business section.**

NATIONAL Parks Airways, the air-transport line between Great Falls, Mont., and Salt Lake City, Utah, has been aptly termed "The Scenic Route." During the course of the 500-mile trip, the passenger crosses the Continental Divide three times, and there unfolds beneath him practically every type of scenery. Despite the altitude and the roughness of the terrain, the route has not proved a difficult one from a flying standpoint.

National Parks Airways ranked first among the lines of the United States in percentage of scheduled miles flown during the first year of its operations, and in each succeeding year it has been second in that respect. Its pilots are thoroughly familiar with the country crossed, and are never out of reach of a place where a landing could be made if necessary. Fortunately, 2,000,000 miles have been flown in three and a half years without a landing having been required because of motor trouble. Officials of the line attribute this record to adherence to a rigorous schedule of day-to-day inspection of motors and to their thorough overhauling after each has completed a prescribed period of service.

From the time he leaves Salt Lake City until he reaches Great Falls, the traveler on this line traverses a route which was at one time replete with thrills and adventure. Here ran the trails which the first inhabitants and explorers followed. Unconsciously, the air-passenger's mind wanders back to the pages of history books, and he cannot help but make comparisons with the days when cross-country travel was an experience which called for a measure of resourcefulness and hardihood possessed by few persons today.

Between Salt Lake City and Pocatello, Idaho, which latter place takes its name from a famous Indian chieftain, the air tourist looks down upon a great expanse of territory which is closely identified with the early history of the Mormon development. Intensive cultivation furnishes evidence of Mormon thrift and industry. Until the Utah-Idaho state line is crossed, Great Salt Lake is always in the field of vision.

Next there comes into view Montana's richest historical district. The dots on the landscape which are Virginia City, Bannack, and Alder Gulch turn the forces of imagination loose and recall to mind the romance that marked life in these early-day mining camps. All the elements of drama were there—the vicissitudes of life in general, the colossal fortunes that were made, the unceasing fight against the forces of nature and, later, against the road agents who preyed upon all and whose misdeeds ran the gamut from petty robbery to murder. The old stagecoach road from Corrine, Utah, to Butte is traversed in fewer hours than it formerly took days. From Butte to Helena, the hills are dotted with the outward

**Type 30 air compressor in the Butte shops of National Parks Airways.**

**Workmen rebuilding a Fokker plane in the Butte shops. Seven ships of the line have recently been made over.**

manifestations of the early prospectors' toil. Still the route clings closely to the road the pioneers followed.

At Helena the passenger can rebuild in his mind the picturesque town that was there in the gold-rush days. He can vision the main street that wound up the canyon and was flanked by frame structures which housed stores, saloons, and honky-tonks. Modern buildings have replaced them now; but the city stands on the same ground it occupied when placer miners sluiced more than $30,000,000 in gold from the neighboring gravel deposits.

On the last leg of the trip, from Helena to Great Falls, more history can be lived over. Below stretches the Missouri River, the route over which Lewis and Clark made their memorable trip in 1805 to learn what the United States had really acquired through the Louisiana Purchase. The daily journal of these intrepid explorers devotes many pages to a description of this section of their journey. Winging his way along comfortably overhead, the passenger can close his eyes and conjure up a scene of a small band of men alternately towing, rowing, and poling their clumsy craft up the waters of the river they hoped would lead them to the Pacific.

As mentioned previously, vigilance keeps the planes of the company airworthy at all times and makes possible a record of safe operation which promotes in patrons of the line a sense of security that all is well. Compressed air plays an effective part in this all-important care of equipment. At the Butte hangar of National Parks Airways there is installed an Ingersoll-Rand Type 30 air compressor of 20 cubic feet per minute piston displacement. It is driven through a V-belt from a 5-hp. electric motor which utilizes 3-phase, 60-cycle, 220-volt current. Compressor and driver are mounted on top of a 20x60-inch receiver or tank, which arrangement provides a compact, dependable source of air supply.

This air serves a variety of purposes in the shops. Motors, fuselage, and wings are blown free of dust and dirt through suitable nozzles. Painting is done with two Size 6 Binks spray guns. A bench-type sand-blasting apparatus is used to clean and brighten up tubular welded forms. And, of course, air is furnished for inflating the pneumatic tires on the landing gear.

National Parks Airways has just completed the rebuilding of seven planes. It has been decided to recoat the metalwork with a transparent protective finish which will permit a more careful inspection of these parts than was possible when ordinary paints and enamels were applied. The new covering material will be sprayed on with air guns.

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### IMPROVEMENT IN RAIL-MAKING

WHAT is claimed to be a great improvement in rail-making processes has been developed by I. C. Mackie, chief of the metallurgical department of the Dominion Iron & Steel Company, and put to use in the Sydney steel plant of the Dominion Steel & Coal Corporation. The important feature of the invention, says *The Engineer*, relates to the discovery, after several years of intensive research, of the precise stage in the production of rails when too rapid a cooling results in "shatter cracks". From such cracks transverse fissures develop when the rails are in service.

By the Mackie method, the cooling of the rails is checked and regulated before the critical stage is reached. This is done by means of cooling tanks that are arranged so as to reduce the heat by carefully graduated degrees. From 24 to 30 hours elapse from the time the rails arrive at the cooling tanks until they are ready for the inspection tests.

## FOREST PRODUCTS LABORATORY TO HAVE NEW HOME

THE United States Forest Products Laboratory, at Madison, Wis., is to have a new home that will enable it to do on a far larger scale than ever before its important researches for the benefit of the people at large. These have to do not only with conservation and reforestation but with every department of the wood-working industries.

The new building is to be ready sometime this year, and will be, according to all accounts, the world's largest and most complete establishment of its kind. The plans call for a U-shaped structure six stories high, with a total floor space of 175,000 square feet. One end of the building, from top to bottom, will be occupied by a pulp-and-paper laboratory that will include grinders, a digester tower 40 feet square, beating and refining apparatus, and a paper-making machine with all its moving parts under precision control. There will also be housed under the same roof a capacious timber-preservation laboratory that is to be provided with every facility for the study of wood fungi and insect pests, a general chemical section, a wood-fermentation plant, fractionating stills, and other departments that will enable the investigators to look into such associate problems as fireproofing, gluing, painting, and finishing wood.

WORKING FOR THE SOVIETS, by Walter Arnold Rukeyser. Published by Covici-Friede, Inc., New York. Price, $3.00.

MR. RUKEYSER has here set down in an interesting manner his experiences as adviser to the Asbestos Trust of the Russian Government on two separate occasions during 1929 and 1930. An American engineer, he went to Russia, like many others of his profession, on a contract basis. Most of his time was spent in a remote town in western Siberia which, given impetus by the asbestos extraction, grew in two years into a modern city of 40,000 persons. Meanwhile, despite expensive but ill-adapted equipment, asbestos production rose from 3,300 to 62,000 short tons per annum. The account is rich in portraits of individual Russians of all types; and gives the reader a good idea of how the great Soviet experiment is working out in actual practice.

MY JUNGLE BOOK, by Herbert Spencer Dickey. An illustrated book of 310 pages, published by Little, Brown & Company, Boston. Price, $3.50.

AS DOCTOR Dickey, the internationally known explorer who wrote this account spent many years as physician and surgeon for mining companies and sugar and rubber producers in various parts of tropical America. He has lived virtually all the past 31 years south of the equator, and in the last five of those years has led five parties up the Orinoco and Amazon rivers. He writes of general experiences rather than of specific trips, with numerous sidelights on such matters as visionary construction schemes, the slaughter of wild life to provide museum specimens, the inherent courtesy and kindliness of the savage races, and the alleged quackery of most so-called scientific expeditions. The book is one to furnish vicarious adventure for those of us who are held to more commonplace pursuits amid prosaic surroundings.

SILVER STRIKE, by William T. Stoll and H. W. Whicker. An illustrated volume of 273 pages, published by Little, Brown & Company, Boston. Price, $2.50.

THIS is the story of the Coeur d'Alene silver-mining district of Idaho, which started as a gold camp, stagnated, and then found a new life which added $250,000,000 to the world's store of metal and helped at least 50 men to become millionaires. As a young lawyer, Mr. Stoll left a non-paying practice in Spokane to cast his lot with the stampeders into the new empire. He settled at Murray and became part and parcel of the drama which this book records in vivid and fascinating style. Mr. Whicker did the actual writing, which is forceful and entertaining in style. The narrative is one that will appeal to both the general reader and the man who follows mining for a livelihood.

AMERICAN INDUSTRY IN EUROPE, by Frank A. Southard. A book of 279 pages, published by Houghton Mifflin Company, Boston. Price, $3.00.

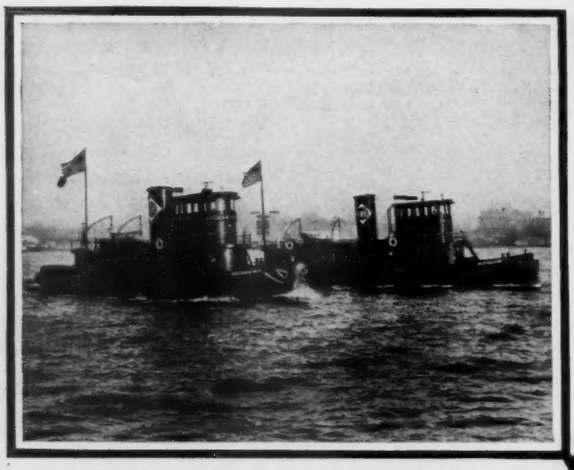
DOCTOR Southard here gives an intimate and detailed account of the monumental industrial and commercial stake which the United States has transplanted across the Atlantic. The author is assistant professor of economics at Cornell University. In essay form, his work was awarded first prize in a nation-wide contest. The book sets forth the results of a study of 101 typical American manufacturers who have set up 118 factories and 259 subsidiaries in Europe with an aggregate investment of $1,300,000,000. We are shown how the business hand of Uncle Sam has reached out to supply many of the foreign nations. Doctor Southard is concise and meticulous in his efforts to present facts only. His book, as a result, is highly informative upon the way in which international business is done.

International News Reel Photo.

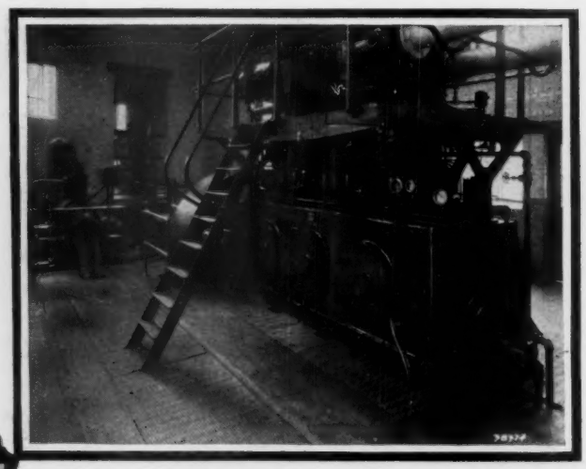
**Compressed air is speeding the work of carving a Canadian war memorial in Dalmatian granite at Vimy Ridge, France. Sand, blown through stencils, is the cutting medium. The complete monument will rest upon 20,000 tons of concrete.**

# Solid Injection Diesels!

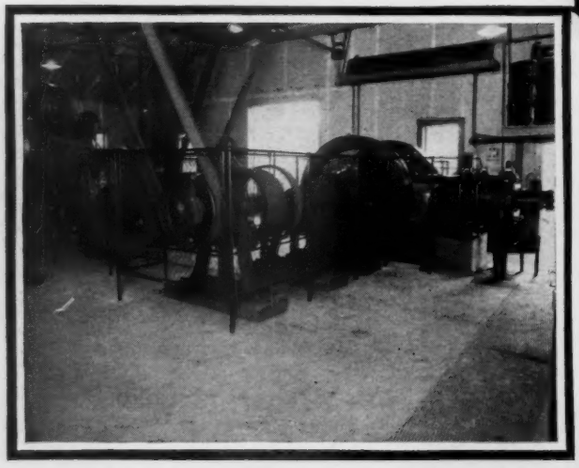
***Their field of application is continually expanding. Have you considered them for the solution of your operating problem?***



*Two of four I-R Diesel tugboats owned by the Erie railroad. Each of the four tugs is equipped with two I-R Diesels developing 1000 s. hp. per boat. All four boats are of identical construction.*



*A 350 hp. I-R Diesel geared to a triplex pump in a water plant. This plant also has a 190 hp. I-R vertical Diesel engine-compressor unit (seen through doorway) and a 110 hp. I-R horizontal Diesel engine-compressor unit.*



*A 110 hp. I-R horizontal Diesel which drives a triplex pump, a compressor, and a vacuum pump at a water flooding station in the Pennsylvania oil fields.*

*One of seven I-R Diesel powered locomotives used in switching service by the Bush Terminal, Brooklyn, N. Y.*

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